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GRAIN and RAIL IN WESTERN CANADA

THE REPORT OF THE GRAIN HANDLING AND TRANSPORTATION COMMISSION

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April 29, 1977.

The Honourable Otto E. Lang, P.C. M.P.,
Minister of Transport, and Minister
Responsible for the Canadian Wheat Board,
House of Commons,
OTTAWA, Ontario

Sir:

We, the Commissioners of the Grain Handling and Transportation Commission, appointed by Orders-in-Council PC 1975-872 and PC 1975-1067:

> To inquire into the rail needs of communities, the economies of a modernized rail system and the probable conduct of producers and elevator companies in changing circumstances for the purpose of making recommendations concerning the future role of that portion of the rail network identified for further evaluation

Now submit Volume 2 of our Report. The seven reports in this compendium are a part of the research program carried out in the course of our evaluation of the grain transportation and handling systems in Western Canada. They are a part of the input to the conclusions reached, and the recommendations made by this Commission in Volume 1.

ALL OF WHICH IS RESPECTFULLY SUBMITTED:

L.G. Stewart
Commissioner

Hon. Emmett M. Hall, Q.C.
Chief Commissioner

R. Lehr
Commissioner

R. Forbes
Commissioner

J.M. McDonough
Executive Director

R.H. Cowan
Commissioner

GRAIN AND RAIL

IN

WESTERN CANADA

VOLUME II

GRAIN AND RAIL IN WESTERN CANADA

VOLUME II

TO THE READER

The seven reports contained in this volume are a part of the research program carried out by the Grain Handling and Transportation Commission in the course of their evaluation of the transportation and grain handling systems in Western Canada. These reports provide an insight into some of the constraints on the retention and expansion of the secondary agriculture industries in Western Canada, as well as a look at the energy implications of changes in the branch line network and the mini-train as an alternative to conventional branch line operations.

These background papers provided a part of the input to the conclusions reached, and recommendations made by the Commission and referred to in Volume I. It is hoped that these papers will provide the reader with an expanded insight into the complexity and ramifications of some of the issues facing the handling and transportation system in Western Canada at this time.

CHAPTER 1

COST OF HAULING GRAIN BY FARM TRUCKS IN WESTERN CANADA

S.N. Kulshreshtha
W.A. Scott

INTRODUCTION

Any decision involving a reduction in the existing number of grain collection points (elevators) on the prairies, in most likelihood would, yield higher costs of transporting grain between farms and the collection points. Any estimation of such costs requires the knowledge of the level of cost of hauling grain by alternative modes (farm trucks, commercial trucks, etc.) as well as the factors affecting the level of this cost. The present report is designed to provide this type of information for farm trucks for Western Canada.

The study has the following objectives:

1) to estimate the total annual cost of hauling grain between farms and a collection point (usually, but not exclusively, country elevators), and to calculate the average cost of hauling,

2) to investigate the behaviour of total and average costs as size of farm and distance to a collection point increase, and

3) to identify the factors affecting average cost of hauling grain by farm trucks.

Scope of the Study

This study is based on an analysis of 417 farm trucks* in various areas of Saskatchewan. Results reported here are based on a survey of

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* A farm truck in this study was defined as the one with a F-plate and used for hauling grain between a farm and a grain collection point (country elevator, feed mill, seed farm, terminal elevator, neighbors' farms, etc.) during 1971-72 crop year.

farm trucks conducted by Kulshreshtha* during 1972-73 for the Government of Saskatchewan. The present study differs from the original study in two respects: one, all the large (in volume hauled) custom truckers have been deleted from the main analysis; two, levels of cost reported here reflect the economic conditions as they existed in 1974.

Organization of the Study

The remainder of this study is divided into three parts: one, description of sample and brief methodology; two, estimates of annual cost of hauling grain and average cost estimates; and three, analysis of factors affecting average cost of hauling grain by farm trucks. The report concludes with a summary of major findings.

ANALYTICAL FRAMEWORK

Selection of Sample

In the past, a number of studies have been carried out related to the cost of hauling grain. The following reports were reviewed:

1) E.W. Tyrchniewicz, A.H. Butler, and O.P. Tangri, The Cost of Transporting Grain By Farm Truck, Centre for Transportation Studies, The University of Manitoba, Res. Rep. No. 8, July 1971.

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* Results of this survey have been reported in S.N. Kulshreshtha, An Economic Analysis of Farm Truck Ownership, Utilization and Cost of Hauling Grain in Saskatchewan, Dept. of Agric. Econ., University of Saskatchewan, RR: 73-09, August 1973.

2) E.W. Tyrchniewicz, The Cost of Transporting Grain by Farm Truck in the Prairie Provinces, A Study Prepared for the Grains Group, October 1970.

3) S.N. Kulshreshtha, An Economic Analysis of Farm Truck Ownership, Utilization and Cost of Hauling Grain in Saskatchewan, A Study Prepared for Grain Handling and Transportation System Rationalization Office, Regina, August 1973.

4) S.N. Kulshreshtha, Cost of Grain Hauling By Farm Trucks in Saskatchewan, Agricultural Science Bulletin, Extension Division, University of Saskatchewan, March 1974.

5) Canada Grains Council, The Grain Handling and Transportation System in the Brandon Area, Winnipeg, 1974

6) Canada Grains Council, Grain Handling and Transportation, Area 11 Study, Winnipeg, October 1975.

7) E.W. Tyrchniewicz, G.W. Moore and O.P. Tangri, The Cost of Transporting Grain by Custom and Commercial Trucks, Centre for Transportation Studies, University of Manitoba, August 1974.

A summary of sample characteristics for these studies is shown in Appendix A.

Of the studies mentioned above, only two studies (No. 2 and 3 above) were based on an original survey of farm grain trucks*; study No. 7 was for commercial and custom trucks, and the remaining studies used these samples in some modified form.

For purposes of conducting the present study, it was agreed at the outset that no new data generation would be carried out. Such a

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* This excludes study No. 1, because it was a part of the sample for the study No. 2.

decision was made in light of two considerations: (i) the existing studies and their sample information were acceptable, and also accessible to the Commission; and (ii) a new survey of a moderate sample size (say 400 to 500 farmers in the three prairie provinces) required a large financial outlay and time resources.

The choice of a sample was then narrowed down to two sets of samples: one, by Tyrchniewicz for the Grains Groups study, and two, that by Kulshreshtha for Saskatchewan. Tyrchniewicz's sample contained a total of 279 farm trucks, of which 120 were in Manitoba, 101 in Saskatchewan and the remaining 58 in Alberta. Kulshrestha's sample consisted of 430 grain trucks (on 380 farms) including 13 large* cumstom truckers**. Both of these sets of samples had features different from each other. The Tyrchniewicz sample offered the following advantages: The sample had farms from all the three prairie provinces, and therefore lent itself to a type of analysis with provincial disaggregation. The Kulshreshtha sample lacked on this characteristic. However, it had the advantage of being more recent (1971-72 vs. 1968-69 for the previous sample), and having been selected by a random sampling process. Furthermore, if factors affecting cost of hauling grain are

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* The term "large" refers to the fact that these individuals engaged heavily in the practice of custom hauling of grain or other products.

** In this study a custom trucker was a farmer, using a F-plate truck, hauling grain for another farmer for an agreed fee.

similar and if their effect is equal in all the three provinces, a sample based on one province might be considered representative of Western Canada*.

The results based on Tyrchniewicz's sample were examined further to test whether there were significant differences among the three provincial subsamples. A cursory analysis indicated that the three provinces might be significantly different from each other. However, this feature of the sample was outweighted by the consideration that the survey referred to 1967-68 period, and in light of structural changes taking place within the industry the results may be of limited value. Attention was subsequently focused on the Saskatchewan sample. Since it included a number of large custom truckers, and since these trucks were not comparable to average farm trucks (in size, utilization and cost), it was decided to use this sample after deleting the 13 large custom truckers in the Goodsoil - Pierceland area of the sample.

Characteristics of Farm and Grain Trucks in the Sample

As mentioned earlier the sample contained a total of 417 trucks. These trucks were maintained on a total of 370 farms (Table I-1). An average farm in the sample maintained 1.127 trucks. On an average, the sample farm was of 1,053 acres, seeded 461 acres to grain crops, and delivered about 11,100 bushels of grain to various outlets.

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* For more elaboration on this point, see Appendix B.

(Table I-2). Average distance between a farm and the country elevator was 10.75 miles*.

TABLE I-1

DISTRIBUTION OF FARMS BY NUMBER OF TRUCKS

Number of Trucks Per Farm	No. of Farms	No. of Trucks
One	326	326
Two	42	84
Three	1	3
Four	1	4
TOTAL	370	417

TABLE I-2

SELECTED FARM BASED CHARACTERISTICS OF THE SAMPLE

Characteristic	Unit	Value for 1971-72
Size of Farm	Acres	1,053
Area Under Grain	Acres	461
One-way Distance to Elevator	Miles	10.75
Total Bushels Delivered	Bushels	11,099.7

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* This average distance is slightly higer than what is considered to be typical distance between a farm and a country elevator. This is because of slightly higher proportion of farms with hauling distance over 30 miles in the sample. This proportion was 13.78 percent as against only 3.1 percent for prairie provinces.

An average truck in the sample was a two-ton, with a gross weight of 19,590 pounds and with a grain box capacity of 208.6 bushels as shown in Table I-3. Average distance between a farm and all the collection points was estimated to be 8.94 miles. This is equivalent to the distance per load when all delivery points' distances are weighted according to share of total grain received. Average output of the grain truck -- as measured by bushel mile* -- was estimated to be 88,022 bushel miles.

TABLE I-3

SELECTED TRUCK BASED CHARACTERISTICS OF THE SAMPLE

Characteristic	Unit	Value for 1971-72
Size of the truck	Tons	2.03
Gross Vehicle Weight	000 lbs.	19.59
Capacity of Grain Box	Bushels	208.6
Age of Truck	Years	15.66
Annual Mileage	Miles	3,226.6
Prop. of Grain Miles to Total	%	33
Annual Bushel-Miles	---	88,022
Weighted distance to all outlets	Miles	8.94

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* Bushel-mile is a measure where one bushel of grain travels a distance of one mile.

Methods of Estimating Cost of Hauling Grain

In this section the method of estimating various items of cost related to hauling grain by farm trucks is described briefly.* Total cost was divided into three parts:

- Total Annual Cost = Annual Common (Fixed) Costs +
  Annual Common (Variable) Costs +
  Direct Costs.

Common costs are those costs related to hauling grain which are incurred for trucs as a whole; their share for grain hauling is apportioned using some suitable criterion. Direct costs are those costs which are associated directly with the grain hauling job, and thus, need no apportionment. The criterion chosen to apportion the common costs was the proportion of grain haul miles to annual mileage of the truck.

As mentioned earlier costs in this report reflect the 1974 level. Since the survey data were collected for the 1971-72 crop year, these data were updated using cost indices. These cost indices were derived from Statistics Canada's Farm Input Index**. For the two periods -- 1971-72 and 1974, the value of appropriate indexes were recorded.*** Ratios of the 1974 indices relative to 1971-72 were used to update various cost items. This procedure was followed for all items, except

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* For more detailed description, see Kulshreshtha, 1973, op. cit., pp.78-90.

** For more details see, Statistics Canada, Price and Price Indexes, (62-202), Ottawa.

*** For 1971-72 average index for the period III quarter (1970) to II quarter (1972) was used, whereas for 1974, average index for the calendar year was used.

fuel cost. For fuel prices, no suitable price index was reported by Statistics Canada. Actual fuel prices during 1971-72 and 1974 were therefore used.* The ratio used for this update of cost levels are shown in Table I-4.

The Common (fixed) costs included the following four items:

1) Depreciation Costs: The method of calculating depreciation in this study was a modification of straight-line and annual revaluation method. Furthermore, adjustment was made for increase in the value of truck over time. The following procedure was used for this adjustment:

- Estimate the up-dated purchased value of the truck in 1971-72 as

$$= \left[\text{Original Purchased Value} + \text{Trade In} \right] \times \frac{\text{Price Index of Truck in 1971-72}}{\text{Price Index of Truck in Year of Purchase}}$$

- Determine the 1971-72 value of the truck. (This value was the same as reported at the time of the survey).

- Calculate Annual depreciation as:

$$= \frac{\text{Value in Step (i) - Value in Step (ii)}}{\text{No. of Years truck was maintained.}}$$

In this calculation, price index for the value of truck is required. Source of data is provided in Appendix C.

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* The actual fuel price during 1971-72 was 25.1 cents per gallon, which increased to 38.8 cents by 1974 -- an increase of 54.58 percent. For more details see, "The Energy Implications of Rationalization of Light Density Traffic Branch Lines", prepared for the Grain Handling and Transportation Commission, by Clayton, Sparks and Associates Ltd., 1976.

TABLE I-4

FACTORS USED FOR UPDATING COST DATA FROM 1971-72 LEVELS TO 1974 LEVELS

No. Statistics Canada Index	Value of Index (1961=100) during		Ratio $\frac{1974}{1971\text{-}72}$	Cost Item Updated
	1971-72	1974		
1. Value of Truck	100.9	147.9	1.4658	Depreciation
2. Mortgage Credit	223.1	288.6	1.2936	Interest
3. Building Replacemtn	155.2	211.1	1.3621	Housing
4. Building Repairs	151.9	204.2	1.3443	Housing
5. Motor License and Insurance	151.8	176.3	1.1614	License and Insurance
6. Repairs, Tires and Batteries	138.6	174.5	1.2590	Tires and Batteries, Upkeep and Repairs
7. Monthly Rated Hired Labour	184.7	261.3	1.4747	Labour

Source: Stat. Can., Price and Price Indexes.

2) Interest Costs: This cost was simply calculated by using eight percent rate of interest to owned portion of the value of the truck in 1971-72. For the remainder actual interest rate paid was applied.

3) Housing Costs: This cost included depreciation on the building, repairs to the building, and interest on investment. Rates of depreciation, and of repairs were five percent and two percent of the value of building, whereas a rate of interest equal to eight percent was charged.

4) License and Insurance Costs: Actual license and insurance fees paid were used.

The Common (Variable) Costs included two items of costs:

1) Tires and Batteries Costs: These were the actual levels of costs incurred by farmers during the survey year.

2) Repairs and General Upkeep Costs: The latter category of cost included expenditures incurred on minor tune-up, lubrication, small repairs, changing oil and anti-freeze, and other general related expenses. These costs were used directly from the questionnaires.

Major repairs included items of more lasting in nature. Items such as a new engine, a major overhaul of an engine, or similar expenditures were included in this category of costs. Although such cost expenditures could have been spread out over a number of years, no such attempt was made, since in a large sample it was expected that such expenditures would be averaged out with those trucks with no such cost in that particular year.

These costs included both the labour cost as well as the cost of parts and other supplies. An hourly charge of $2.25 was used to estimate the labour cost in 1971-72.

The direct costs of hauling grain included two items:

1) Fuel Costs: Fuel costs were derived by determining price paid for fuel, and farmers' estimate of average miles per gallon. These figures were used in conjunction with grain haul miles to estimates annual fuel costs.

2) Labour Costs: This cost was divided into two parts:

   - Dead-haul labour costs: which is the time required for loading and unloading of the truck, and waiting at the country elevator.

   - Driving labour cost: this is the time it took a farmer to transport his grain (after loading) from the farm to the country elevator (or to other delivery outlet).

It was further assumed that all trips made to the country elevators were single purpose trips; i.e. grain delivery trip.

This labour input was evaluated by using an hourly wage rate of $2.25 in 1971-72.

After the calculation of total annual cost of hauling grain, the following cost measures were derived:

- Average cost per bushel: which is the total cost ÷ total bushels delivered during the year.

- Average Cost per Bushel-Mile: which is the total annual cost ÷ total bushel-miles for the truck.

COST OF TRANSPORTING GRAIN BY FARM TRUCKS IN 1974

In this section the cost of hauling grain by farm trucks between a farm and delivery outlet are reported. These estimates were derived

using the methodology reported in the previous section. Furthermore, as already noted, the 13 custom truckers were deleted and the subsequent estimates relate to a grain truck not actively involved in custom trucking.*

Total Annual Cost of Hauling Grain

Total annual cost of hauling grain during 1974 was estimated to be $521.38 per truck.** Of this total cost the items of major importance were dead-haul and driving labour, depreciation and repairs and upkeep costs. Common costs (both fixed and variable) accounted for 51.8 per cent of the total, whereas the remaining 48.2 percent were direct costs. (Table I-5). The fixed common costs per grain truck were $179.94 or 34.5 percent of the total grain hauling costs, whereas the variable common costs were $90.39 per grain truck, or 17.3 percent of the total grain hauling cost.

Largest single component of the total cost was dead-haul labour (22.1 percent) followed by depreciation (19.9 percent) and driving labour (17.1 percent). Since labour input is imputed (since most part of this labour is supplied by operator and family members), the out-of-pocket costs of transporting grain are substantially lower than $521.38 per annum.

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* Cost of hauling grain for these 13 custom truckers, along with selected farm and truck based characteristics are presented in Appendix D.

** This implies that if a farm used more than one truck for hauling grain, his cost, on an average, would be a multiple of this number and the number of grain trucks.

TABLE I-5

LEVEL AND DISTRIBUTION OF ANNUAL COST OF HAULING GRAIN BY FARM TRUCKS IN WESTERN CANADA, 1974

Particulars	Amount in $	Percent of Total Cost
Depreciation Cost	103.55	19.9
Housing Cost	9.77	1.9
Interest Costs	51.27	9.8
License & Insurance Cost	15.36	2.9
Common (Fixed) Costs	179.94	34.5
Tires and Batteries Costs	29.43	5.6
Repairs and Upkeep Costs	60.96	11.7
Common (Variable) Costs	90.39	17.3
Fuel Costs	46.62	8.9
Dead-haul Labour Costs	115.36	22.1
Driving Labour Costs	89.07	17.1
Direct Costs	251.05	48.2
Total Cost	521.38	100.0

Average Cost of Hauling Grain

Total annual costs were converted to average (per unit) costs. Two types of unit costs presented are: average cost per bushel, and average cost per bushel-mile. Results are shown in Table I-6. Average common fixed costs were estimated to be 1.827 cents per bushel and 0.204 cents per bushel-mile. Average direct costs were 2.549 cents per bushel and 0.285 cents per bushel-mile. Average total cost (including commong and direct costs) per bushel for 1974 was estimated to be 5.294 cents and that per bushel-mile to be 0.592 cents.

One might wonder whether the average costs shown in Table I-6 are representative of the situation that existed in the prairie provinces during 1974. To test this, estimates of cost using the sample data were weighted by prairie provinces' distribution of permit holders by hauling distance. Results are shown in Table I-7. The average cost per bushel was estimated to be 5.602 cents, whereas that on a per bushel-mile basis to be 0.593 cents. One must note that weighting of various farm situations was done only on the basis of distance to country elevator; no consideration was made to distribution of farms of various sizes within a distance range. Furthermore, in this classification weighted distance to all delivery outlets was not considered, and to the extent the distance to elevator is different from the weighted distance, overall average costs figure may be different. However, based on this crude aggregation, the average costs as reported in Table I-6 are representative of the average conditions in the prairie provinces during 1974.

TABLE I-6

AVERAGE COST OF HAULING GRAIN BY FARM TRUCKS IN WESTERN CANADA, 1974

Particulars	Per Bushel	Per Bushel-mile
	---------- cents	------------
Average Common (Fixed) Costs	1.827	0.024
Average Common (Variable) Costs	.918	0.103
Average Direct Costs	2.549	0.285
Average Total Cost	5.294	0.592

RELATIONSHIP BETWEEN AVERAGE COSTS, VOLUME OF GRAIN DELIVERED AND DISTANCE TO ELEVATOR

In order to investigate the above interrelationships, the sample of 417 trucks was stratified by two characteristics: one, distance between a farm and country elevator, and two, annual volume of grain delivered by the truck. Nine distance categories and seven volume categories were selected, resulting in a total of 63 cells. However, 21 of such cells had zero frequency, leaving only 52 cells with any grain truck. Characteristics of such trucks, along with information on a total and average costs are summarized in Table I-8. A few tendencies in this table are noteworthy:

TABLE I-7

APPROXIMATE TOTAL ANNUAL COST AND AVERAGE COST FOR PRAIRIE PROVINCES, 1974

Distance Range (miles)	Percent of Total Farmers in Prairie Provinces 1973-75	Average Per Farm Truck: Total Cost of Hauling	Average Per Farm Truck: Bushels Delivered	Average Per Farm Truck: Bushel-Miles
0-3	11.8	454.16	12,201	71,357
3-6	25.8	452.83	9,913	64,104
6-10	28.8	671.00	11,998	103,769
10-15	19.0	597.99	8,700	113,093
15-20	7.3	559.52	5,732	116,528
20-25	2.9	266.28	1,804	44,248
25-30	1.3	351.58	3,970	114,596
30 +	3.1	444.59	2,784	132,104
Weighted Average		544.21	9,714.4	91,707

Weighted Provincial

Average per Bushel 5.602 cents

Average Cost per Bushel-Mile 0.593 cents

Source: Col. 2, Canada Grains Council, Distribution of Present Delivery Miles among Permit Holders; Col. 3, 4 and 5 based on Saskatchewan sample

TABLE I-8

RELATIONSHIP BETWEEN COST OF HAULING,

VOLUME OF GRAIN DELIVERED (PER TRUCK) AND DISTANCE TO ELEVATOR

Distance To Elevator	Characteristics	Unit	Volume Delivered Per Truck Per Annum (Bushels)						
			≤ 3,000	3001-6000	6001-10,000	10,001-15,000	15,001-20,000	20,001-25,000	25,001+
0-3 miles	No. of Trucks	#	12	15	18	18	8	5	7
	Capacity of Grain Box	Bu.	112.5	167.7	188.9	261.3	220.6	282.0	297.1
	Total Bu. Hauled	Bu.	1,781	4,765	7,773	12,631	16,515	22,412	44,245
	Weighted Distance	Miles	3.97	3.31	3.95	5.59	4.21	16.47	4.43
	Common (Fixed) Costs	$	35.29	78.04	106.02	116.31	185.26	884.16	453.63
	Direct Costs	$	92.84	126.73	174.89	189.25	327.72	419.26	492.55
	Total Costs	$	146.26	236.08	315.64	394.93	718.92	1,393.58	961.04
	Av. Cost/Bu.	¢	8.21	4.93	4.06	3.13	4.35	6.22	2.17
	Av. Cost/Bu. Mile	¢	2.068	1.490	1.028	.559	1.034	.377	.490
3.1-6 miles	No. of Trucks	#	21	25	24	28	16	5	5
	Capacity of Grain Box	Bu.	137.4	155.6	198.5	230.3	214.1	280.0	242.0
	Total Bu. Hauled	Bu.	1,899	4,506	7,929	12,391	17,117	23,392	29,728
	Weighted Distance	Miles	4.728	5.013	5.893	6.435	6.802	4.21	9.99
	Common (Fixed) Costs	$	47.22	77.32	150.50	178.63	201.28	424.52	332.66
	Direct Costs	$	69.58	170.76	224.69	263.98	391.96	356.56	402.66
	Total Costs	$	148.24	312.43	445.34	531.03	712.14	828.72	826.76
	Av. Cost/Bu.	¢	7.807	6.933	5.617	4.285	4.160	3.543	2.781
	Av. Cost/Bu. Mile	¢	1.651	1.383	.953	.666	.612	.841	.278

Cont'd

TABLE I-8 (Cont'd)

Distance To Elevator	Characteristics	Unit	Volume Delivered Per Truck Per Annum (Bushels)						
			≤ 3,000	3001-6000	6001-10,000	10,001-15,000	15,001-20,000	20,001-25,000	25,001+
6.1-10 miles	No. of Trucks	#	8	19	23	24	17	12	5
	Capacity of Grain Box	Bu.	150.6	172.4	212.2	224.6	248.8	257.1	320.0
	Total Bu. Hauled	Bu.	1,670	4,526	8,029	12,194	17,861	22,075	30,121
	Weighted Distance	Miles	7.726	8.724	10.122	9.073	7.147	8.796	8.821
	Common (Fixed) Costs	$	48.00	135.87	154.42	224.70	268.16	321.85	784.00
	Direct Costs	$	55.17	167.32	241.96	307.77	445.30	558.12	734.94
	Total Costs	$	140.85	392.63	480.03	665.32	887.97	1,030.17	1,883.2
	Av. Cost/Bu.	¢	8.434	8.675	5.978	5.456	4.971	4.667	6.252
	Av. Cost/Bu. Mile	¢	1.092	.994	.591	.601	.696	.530	.709
10.1-15 miles	No. of Trucks	#	15	6	10	8	6	3	1
	Capacity of Grain Box	Bu.	168.7	254.2	222.0	242.5	259.2	310.0	350.0
	Total Bu. Hauled	Bu.	1,848	4,824	8,375	11,578	16,302	21,812	30,000
	Weighted Distance	Miles	13.12	12.442	11.512	13.205	14.653	12.335	13.00
	Common (Fixed) Costs	$	49.62	116.72	268.44	284.31	320.00	664.67	240.20
	Direct Costs	$	85.41	206.03	317.18	386.94	408.12	534.33	614.10
	Total Costs	$	173.93	352.83	697.32	869.34	938.72	1,322.53	1,048.30
	Av. Cost/Bu.	¢	9.411	7.314	8.326	7.508	5.758	6.063	3.500
	Av. Cost/Bu. Mile	¢	.717	.588	.723	.569	.393	.491	.270

TABLE I-8 (Cont'd)

Distance To Elevator	Characteristics	Unit	Volume Delivered Per Truck Per Annum (Bushels)						
			_ 3,000	3001-6000	6001-10,000	10,001-15,000	15,001-20,000	20,001-25,000	25,001+
15.1-20 miles	No. of Trucks	#	1	2	0	1	0	0	0
	Capacity of Grain Box	Bu.	50	287.5		200.0			
	Total Bu. Hauled	Bu.	950	4,788		12,400			
	Weighted Distance	Miles	16.0	22.482		19.0			
	Common (Fixed) Costs	$	8.20	181.05		263.70			
	Direct Costs	$	108.30	168.50		394.20			
	Total Costs	$	137.00	387.95		1,325.20			
	Av. Cost/Bu.	¢	14.42	8.10		10.70			
	Av. Cost/Bu. Mile	¢	.901	.360		.600			
20.1-25 miles	No. of Trucks	#	4	1	0		0	0	0
	Capacity of Grain Box	Bu.	100.0	200.0					
	Total Bu. Hauled	Bu.	1,057.5	4,790					
	Weighted Distances	Miles	23.99	25.00					
	Common (Fixed) Costs	$	30.35	233.10					
	Direct Costs	$	76.27	317.10					
	Total Costs	$	146.82	744.10					
	Av. Cost/Bu.	¢	13.88	15.50					
	Av. Cost/Bu. Mile	¢	.579	.600					

Cont'd

TABLE I-8 (Cont'd)

Distance To Elevator	Characteristics	Unit	Volume Delivered Per Truck Per Annum (Bushels)						
			_ 3,000	3001-6000	6001-10,000	10,001-15,000	15,001-20,000	20,001-25,000	25,001+
25.1-30 miles	No. of Trucks	#	9	1	2	2	0	0	0
	Capacity of Grain Box	Bu.	205.5	180.0	337.5	280.0			
	Total Bu. Hauled	Bu.	1,383.1	3,660.0	7,615	12,125			
	Weighted Distance	Miles	29.28	28.50	28.27	29.07			
	Common (Fixed) Costs	$	69.17	233.20	160.95	182.00			
	Direct Costs	$	118.71	198.10	356.05	349.45			
	Total Costs	$	230.22	474.50	554.00	633.85			
	Av. Cost/Bu.	¢	16.64	13.00	7.275	5.227			
	Av. Cost/Bu. Mile	¢	.568	.500	.257	.180			
30.1-40 miles	No. of Trucks	#	12	0	1	0	0	0	0
	Capacity of Grain Box	Bu.	155.8		400.0				
	Total Bu. Hauled	Bu.	1,182		7,000.0				
	Weighted Distance	Miles	37.017		38.00				
	Common (Fixed) Costs	$	39.57		50.10				
	Direct Costs	$	82.58		547.10				
	Total Costs	$	146.12		1,002.10				
	Av. Cost/Bu.	¢	12.36		14.30				
	Av. Cost/Bu. Mile	¢	.334		.400				

TABLE I-8 (Cont'd)

Distance To Elevator	Characteristics	Unit	Volume Delivered Per Truck Per Annum (Bushels)						
			_ 3,000	3001-6000	6001-10,000	10,001-15,000	15,001-20,000	20,001-25,000	25,001+
40.1-60.1 miles	No. of Trucks	#	13	6	0	0	0	0	1
	Capacity of Grain Box	Bu.	166.1	375.0					450.0
	Total Bu. Hauled	Bu.	1,101.5	4,561					29,000
	Weighted Distance	Miles	48.70	49.00					52.76
	Common (Fixed) Costs	$	105.18	306.08					1,366.40
	Direct Costs	$	135.72	337.38					1,495.20
	Total Costs	$	315.42	791.25					3,067.90
	Av. Cost/Bu.	¢	28.63	17.35					10.600
	Av. Cost/Bu. Mile	¢	.588	.354					.200

1) As either the volume delivered or distance to elevator increased, there was a tendency in the truck size (as measured in terms of capacity of grain box) to increase as well.

2) There was no apparent relationship between volume delivered and distance to all delivery points.

3) As volume delivered increased average cost per bushel-mile declines. A similar tendency was observed for the average cost to decline as weighted distance to all delivery points increased (Figure I-1).

ECONOMETRIC ANALYSIS OF FACTORS AFFECTING AVERAGE COST OF TRANSPORTING GRAIN

The 417 grain trucks were further examined for any regularities that might exist among cost of transporting and various characteristics of the truck (and/or farm). Both the unit costs -- average cost per bushel and average cost per bushel-mile -- were examined. The following variables were hypothesized to affect the level of average cost:

x_1 = Size of truck. This variable was measured in two alternate forms: in tons and in terms of capacity of the grain box;

x_2 = Volume of grain delivered by the truck per annum;

x_3 = Age of the truck;

x_4 = Annual utilization of the truck;

x_5 = One-way distance to delivery point. This variable was measured in two alternate ways: distance to the country elevator and weighted distance to all delivery points;

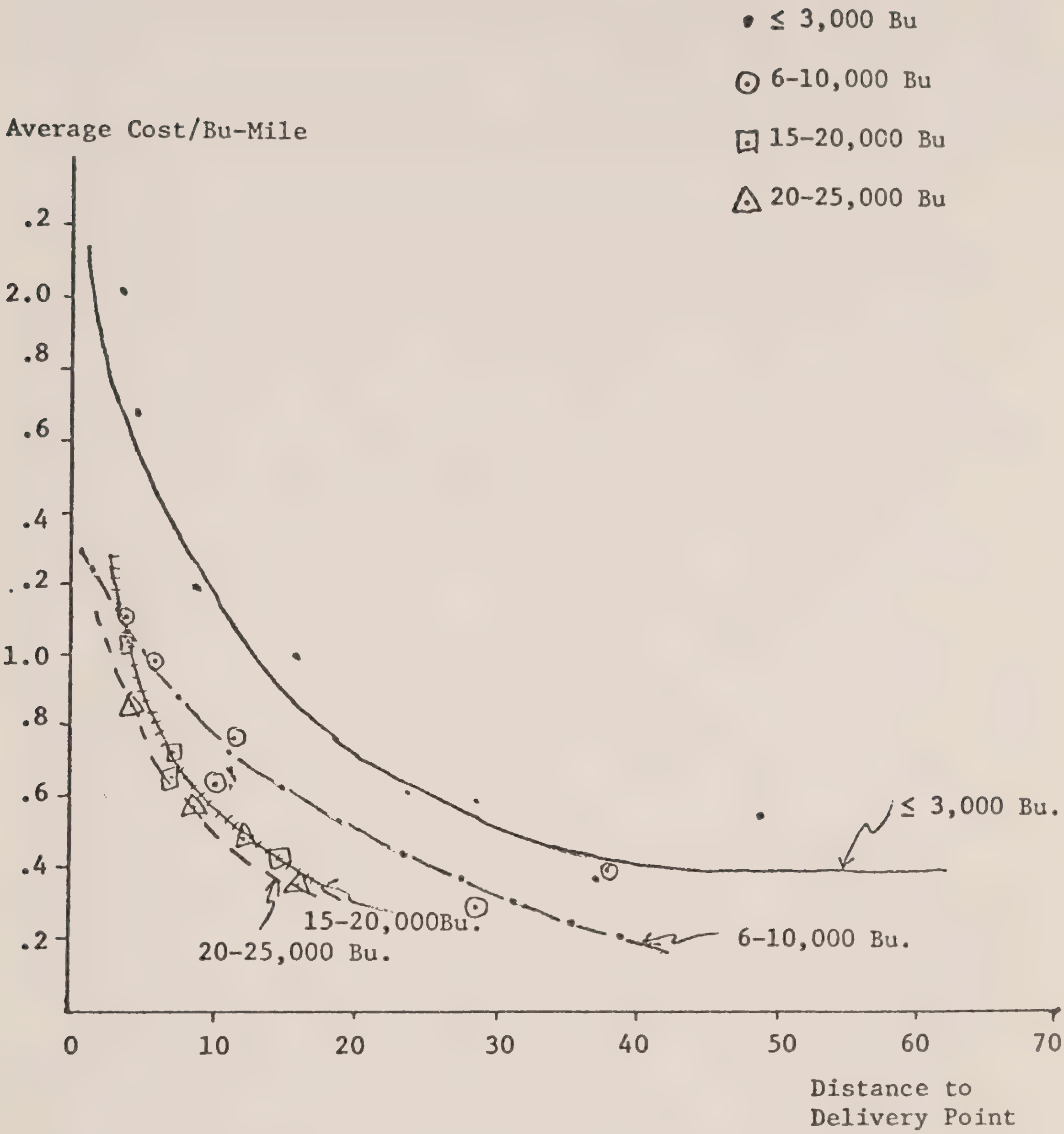

Figure I-1: Relationship among distance to Elevator, Volume of Grain delivered per truck, and Average cost per Bushel-Mile, 1974.

X_6 = Nature of road surface travelled, expressed as proportion (percent) of paved road to total distance;

X_7 = Output of the truck, as measured by annual bushel-miles generated.

The following specifications were hypothesized:

Where Y_1 = Average cost per bushel,

Y_2 = Average cost per bushel-mile.

Average cost per bushel:

$$Y_1 = f(X_1, X_2, X_3, X_5, X_6)$$

$$Y_1 = f(X_1, X_2, X_3, X_4, X_5, X_6)$$

Average cost per bushel-mile:

$$Y_2 = f(X_1, X_2, X_3, X_5, X_7)$$

$$Y_2 = f(X_1, X_2, X_3, X_4, X_5, X_7)$$

The size of the grain truck was expected to exert a downward pressure on average cost because of a more efficient utilization. Similarly the age of the truck and annual utilization of the truck were expected to be negatively related with average cost. One of the explanations for lower average cost for the older truck is the smaller depreciation, which may be partially offset by larger repairs and general maintenance expenditures. Distance travelled variable could be hypothesized to influence average cost both positively as well as negatively. The positive influence of this variable may be as a result of a change in the nature of truck required to adequately perform the hauling function.

It is conceivable that as hauling distance increases, farmers may have to purchase larger and/or newer trucks which would increase the average cost. On the negative influence, it is conceivable that longer distance would result in larger annual utilization and thereby, would reduce average costs.

The nature of the road surfaces travelled (paved vs. unpaved) was hypothesized to have a negative influence. This was based on the fact that on paved road costs of upkeep, tires, and of other repairs are somewhat lower. The output of a truck (bushel-miles) was hypothesized to have negative influence on cost per unit of output since with increased output the fixed costs are better distributed, resulting in a decline in total cost.

Results are shown in Tables I-9 and I-10. Results for the average cost per bushel relationships were expected on a priori basis. Furthermore, all coefficients were found to be statistically significant at one percent or less. The only exception to this was the coefficient for the road surface which was positive, but insignificant. It was subsequently deleted. Based on the goodness of fit criterion equation (5) in Table I-9 was selected. Average cost per bushel increased as one-way distance to elevators increased. However, average cost per bushel exhibited a tendency to decline as a larger truck was used, as truck age increased, as volume delivered increased, and as annual utilization increased. A one percent increase in the volume hauled decreased average cost per bushel by 0.150 percent. Similarly, an increase in the distance to various delivery points by one percent increased average cost by 0.475 percent.

TABLE I-9

REGRESSION COEFFICIENTS FOR FACTORS AFFECTING AVERAGE

COST PER BUSHEL, SASKATCHEWAN, 1974

(All Variables in Log Form)

Eq. No.	Intercept	Size of Truck Tons	Capacity of Grain Box (Bu)	Total Bu. Hauled	Age of Truck	Annual Mileage	One Way Distance To Elev.	Weighted Distance to Delivery Point	Paved Miles (Percent of Total)	R^2	$S_{\hat{y}}$
1.	1.559*** (.111)	-.192*** (.047)		-.241*** (.023)	-.094** (.034)		.342*** (.027)		.011 (.011)	.606	.188
2.	2.341*** (.146)	-.308*** (.046)		-.177*** (.024)	-.244*** (.037)	-.271*** (.035)	.452*** (.029)		.009 (.011)	.655	.176
3.	3.095*** (.173)		-.397*** (.051)	-.149*** (.024)	-.265*** (.037)	-.279*** (.034)	.468*** (.029)		.009 (.011)	.668	.173
4.	3.115*** (.180)		-.382*** (.053)	-.182*** (.024)	-.267*** (.038)	-.251*** (.036)		.421*** (.027)		.640	.180
5.	3.110*** (.172)		-.399*** (.050)	-.150*** (.242)	-.267*** (.037)	-.280*** (.035)	.475*** (.028)			.667	.173

Figures in parentheses are standard errors.

*** Significant at 0.1% level.

** Significant at 1% level.

TABLE I-10

REGRESSION COEFFICIENTS FOR FACTORS AFFECTING AVERAGE

COST PER BUSHEL-MILE, SASKATCHEWAN, 1974

Eq. No.	Intercept	Size of Truck Tons	Capacity of Truck (Bu.)	Annual Mileage	Age of Truck to Elev.	One Way Distance to Elev.	Weighted Delivery Distance	Bushel-Miles	Annual Bushels Hauled	R^2	$S_{\hat{y}}$
6.	2.357 (.142)	-.344 (.046)		-.294 (.035)	-.249 (.037)	.333 (.043)		-.834 (.041)	.666 (.045)	.745	.173
7.	3.191 (.169)		-.438 (.050)	-.303 (.034)	-.272 (.036)	.342 (.042)		-.825 (.040)	.687 (.044)	.756	.169
8.	2.382 (.152)	-.304 (.049)		-.238 (.037)	-.243 (.039)		-.381 (.027)	-.211 (.022)		.708	.184
9.	3.123 (.182)		-.389 (.053)	-.246 (.036)	-.263 (.039)		-.393 (.026)	-.185 (.025)		.717	.182

All variables in log form.

All coefficients significant at 0.1% level.

Figures in parentheses are standard errors.

Results for the average cost per bushel-mile are shown in Table I-10. Based on the criterion of goodness of fit equation (7) could be selected. However, in this equation volume delivered variable had a somewhat questionable sign for the coefficient. It was, therefore,deleted and equation (9) was selected. According to this equation, one percent increase in the output of the truck decreased average cost per bushel-mile by 0.185 percent. Results based on this function are plotted in Figure I-2 and I-3. In Figure I-2 interrelationships among average cost, bushel-miles, and size of truck are shown, whereas those for distance volume delivered are shown in Figures I-3 and I-4. Average cost per bushel per mile declined as either distance, volume of grain delivered, or both increased.

SUMMARY

1. An average farm in the sample was of 1,053 acres, situated approximately 10.75 miles from a country elevator, and delivered approximately 11,099.7 bushels to various collection points. An average of 1.127 grain trucks were maintained per farm.

2. An average grain truck was 2.03 tons, with the capacity of grain box of 208.6 bushel, and was 15.66 years old.

3. On an average, a grain truck was used for 3,226.6 miles, of which 33 percent for hauling grain between farm and a collection point. Weighted distance between the farm and a collection point was 8.94 miles.

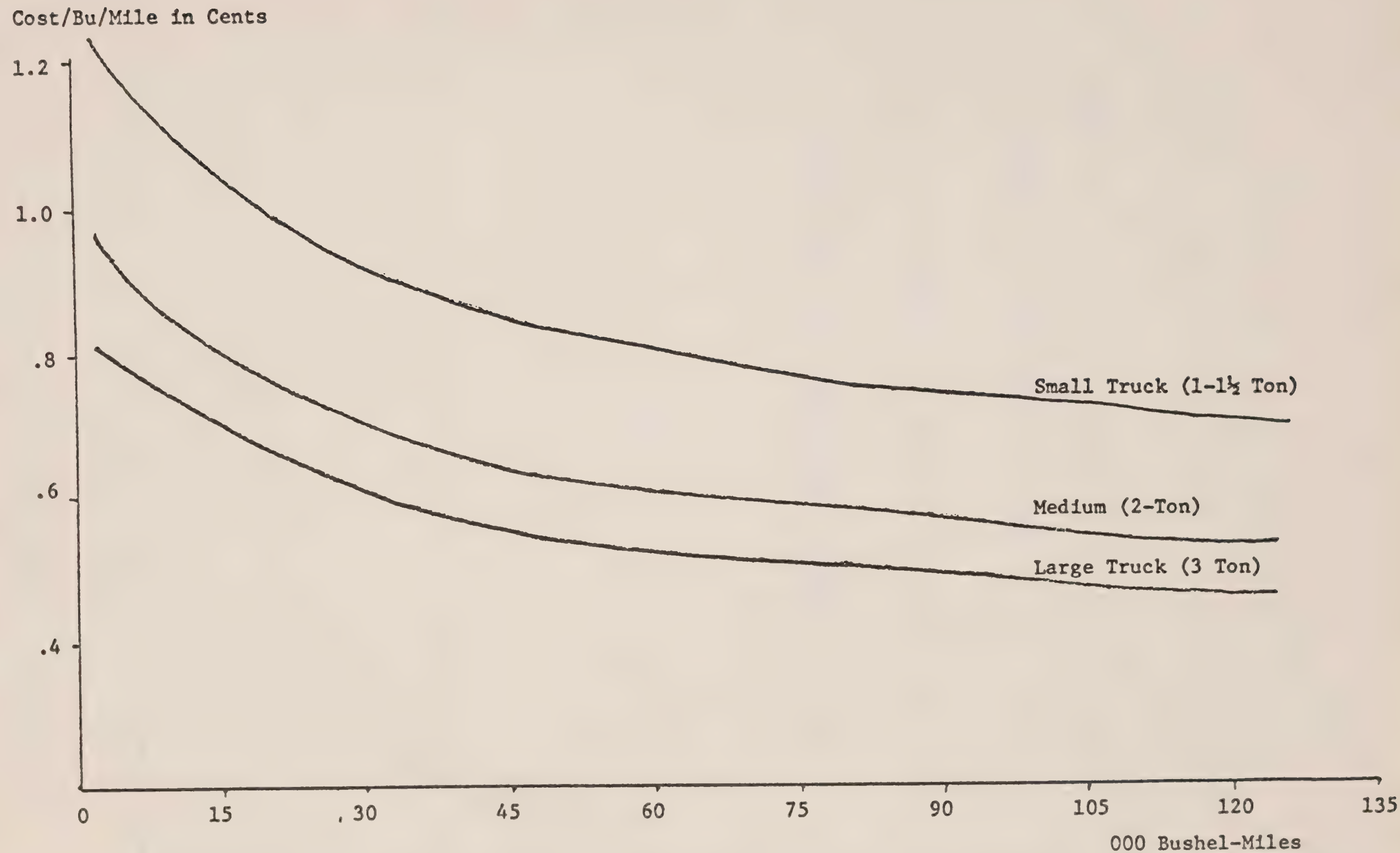

FIGURE I-2: Relationship Between Cost Per Bushel per Mile of Transporting Grain, Bushel-Mile, and Size of Truck, 1974.

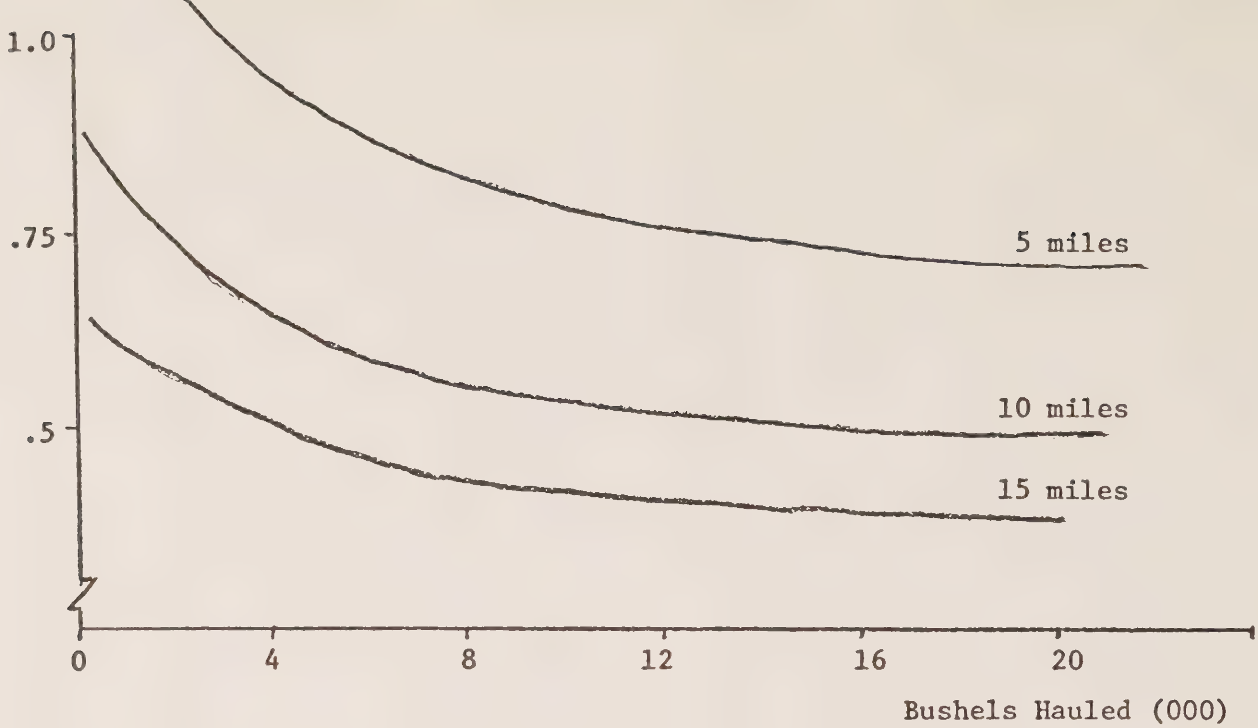

FIGURE I-3: Relationship between Volume Delivered and Average cost for various Distances, 1974.

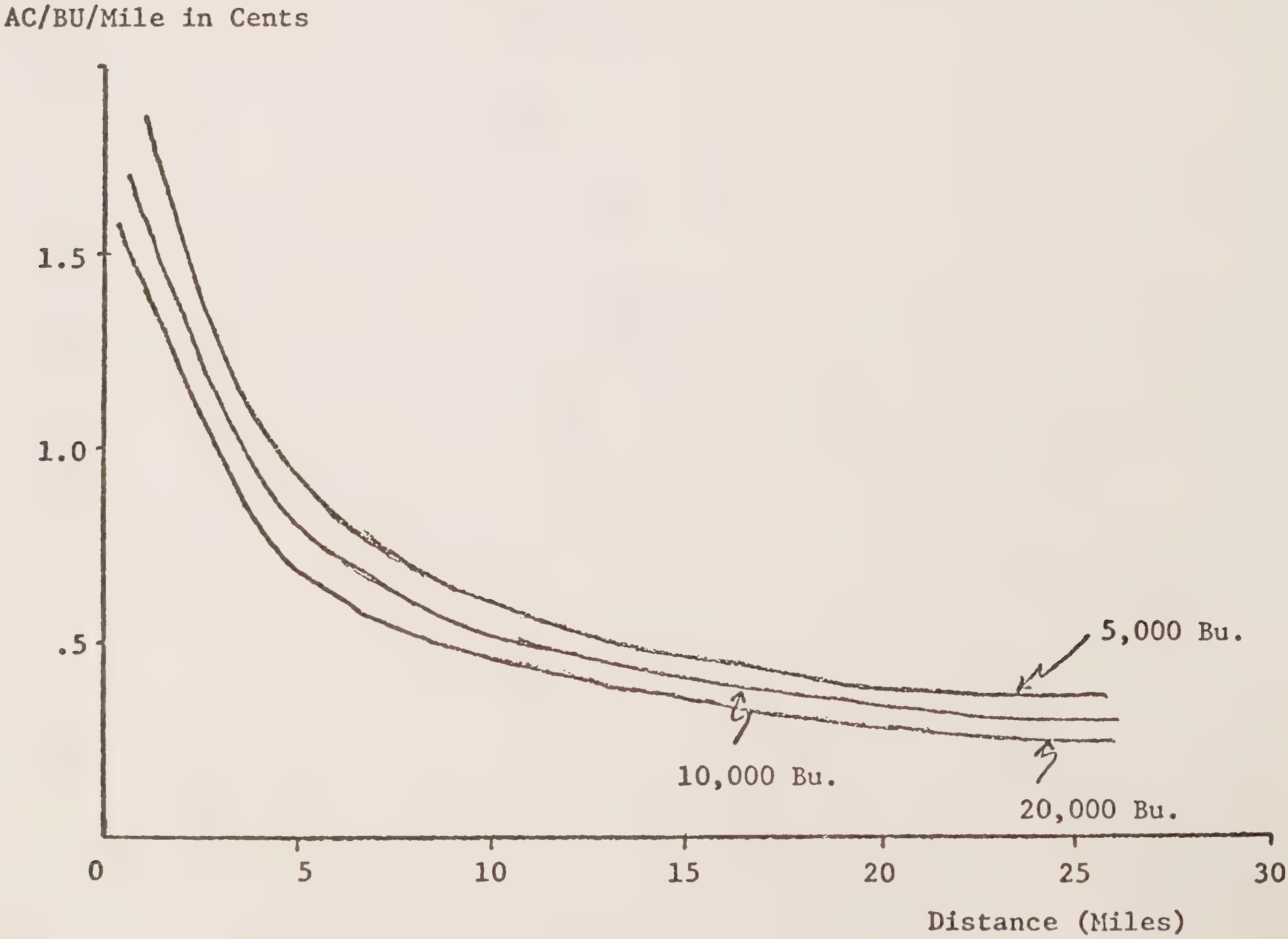

FIGURE I-4: Relationship between Distance to Delivery Point and Average Cost, for Various Volumes Delivered.

4. Total grain transportation cost during 1974 was estimated to be $521.38 per annum.

5. Dead-haul labour and depreciation were the two leading items of expenditure, accounting for 22.1 percent and 19.9 percent of total cost.

6. Average cost of transporting grain was estimated to be 5.294 cents per bushel, and 0.592 cents per bushel per mile. The average cost under existing (1973-74) hauling distance was estimated to be 5.6 and 0.593 cents, per bushel and per bushel-mile, respectively.

7. Trucks were stratified by distance to elevator and annual volume of grain delivered. Based on this analysis there was a tendency in average cost per bushel-mile to decline when either distance or volume increased.

8. Based on regression analysis average cost per bushel per mile declined with an increase in size of truck, its annual utilization, its age and annual bushel-miles.

APPENDIX A

SUMMARY OF SAMPLE
CHARACTERISTICS AND FINDINGS
OF VARIOUS STUDIES ON
COST OF TRANSPORTING
GRAIN BY TRUCK

TABLE I-A.1

SUMMARY OF SAMPLE CHARACTERISTICS

Study	Year of Study	Sample Size	Size of Truck		Annual Mileage	Average Age of Truck	Grain Miles as % of Total	Bushel Miles	Distance to Elevator	Size of Farm	Volume of Grain Delivered
			Tons	Cap.of Grain Box							
Unit				Bu.	Miles	Years	%		Miles	Acres	Bu.
Tyrchniewicz, Butler, Tangri	1967/8	128	1.8	189	3,778	11.5	13.4	40,620	5.5	852	5,230
Tyrchniewicz (Grains Group)	1967/8	279	2.0	217.5	3,766	10	15.8	61,305	6.9	1,066	6,846
Kulshreshtha	1972/3	404	2.06	214	3,505	15.5	24.2	86,201	11.5	831	11,202
Kulshreshtha* (Ext. Div.)	1972/3	352	2.05	208	2,698	16.3	30.7	81,477	6.4	862	12,447
Canada Grains Council - Brandon Area	1971/2	Same as the Study by Tyrchniewicz, Butler & Tangri									
Canada Grains Council - Area II	1973	133	2.19	217	2,519	15.3	33.3	82,981	5.86	1,243	16,401
Tyrchniewicz, Moore, Tangri**	1967/8	45	2.9	327	9,729	7.5	56.5	874,832	21.8	--	40,701

* This sample included the typical hauling areas only.

** This study deals with movement of grain by commercial and custom trucks.

TABLE I-A.2

SUMMARY OF COST OF TRANSPORTING GRAIN

Study	Year of Study	Total Fixed Costs	Total Variable Costs	Total Cost	Fixed Cost as Percent of Total	Average Cost	
						Per Bu.	Per Bu. Mile
Tyrchniewicz, Butler Tangri	1967/8	$ 57.75	$ 97.52	$155.27	37	2.97¢	.382¢
Tyrchniewicz (Grains Group)	1967/8	$ 91.08	$136.67	$227.75	40	3.27¢	.379¢
Kulshreshtha	1972/3	$151.12	$287.01	$438.13	35	4.22¢	.333¢
Kulshreshtha (Ext. Div.)	1972/3	$140.86	$257.05	$397.91	35.5	3.74¢	.475¢
Canada Gr. Council (Brandon Area)	1971/2	--	--	--	--	3.03¢	.551¢
Canada Gr. Council (Area 11)	1973	--	(Not reported)		--	--	--
Tyrchniewicz, Moore Tangri	1967/8	$475.22	$1,011.90	$1,487.12	32	3.65¢	.170¢

APPENDIX B

REPRESENTATIVENESS OF THE STUDY SAMPLE FOR WESTERN CANADA

REPRESENTATIVENESS OF THE STUDY SAMPLE FOR WESTERN CANADA

Since this study employs a sample of grain trucks from one province, namely Saskatchewan, one might wonder about its representativeness for the entire prairie region. To the extent that the three provinces have different hauling conditions, different distribution of farm sizes and enterprise combinations, different estimates of cost of transporting grain would result. However, such differences exist even within a region, and between farms.

The merit of the argument that any subregional sample may not be representative of the entire region rests on two premises: one, that different sets of variables influence cost in different subregions, and two, the magnitude of their effects on the cost are different. These premises were examined further using Tyrchniewicz's sample, for Western Canada. For the first premise it was shown that the same set of factors influenced average cost per bushel (or bushel-mile) in the three provinces. For the second premise the following procedure was used. Multiple regression parameters for average cost of hauling grain (as affected by truck and farm characteristics) in the three provinces were examined for homogeneity. A formal test for homogeneity of parameter could not be applied. Alternatively, for the prairie provinces' coefficient (for a given independent variable) a 90 percent confidence interval was estimated. This confidence interval was used to see whether the coefficients for the three provinces (for the same independent variable) were contained

within it. For the variables examined, such was not the case. However the differences did not appear to be large. One must also bear in mind that this observation is not based on a formal statistical test, and therefore, this conclusions remains at best, tentative.

APPENDIX C

METHOD OF ESTIMATING THE INDEX

FOR VALUE OF TRUCK

PRIOR TO 1961

METHOD OF ESTIMATING THE INDEX FOR VALUE OF TRUCK PRIOR TO 1961

Statistics Canada has recently constructed an index for the value of truck based 1961. One of the problems of using this index over a period of time is that it was not available prior to 1961. However, during 1961 and 1969 Statistics Canada published two indexes:

1) 1961 based index of value of truck, and
2) 1935-39 based index of price of farm machinery.

Using this data, a regression function was estimated using 1935-39 as the independent variable and 1961 based index as the dependent variable, with the following results:

$$Y = 43.9 + .2117X$$

$$r^2 = .962$$

The coefficient was significant at one percent level of significance. This index was used to estimate the 1961 base index for the 1938-1960 period. Results are shown in Table I-C-1.

TABLE I-C.1

ESTIMATION LEVEL OF INDEX (1961 = 100)
OF VALUE OF FARM TRUCKS IN WESTERN CANADA

Year	1935-39 Index (x)	Estimated 1961 = 100 Index $Y = 43.9 + .2117X$
1938	103.7	65.8
1939	103.3	65.8
1940*	105.5	66.2
1941*	108.8	66.9
2*	114.1	68.0
3*	117.1	68.7
4*	118.4	68.9
5*	115.2	68.3
1946*	118.8	69.0
7*	126.4	70.6
8*	138.8	73.3
9	158.4	77.4
50*	165.6	78.9
1951*	187.6	83.6
2*	196.2	85.4
3	197.7	85.7
4	199.2	86.1
5	199.9	86.2
1956	209.9	88.3
7	223.5	91.2
8	235.9	93.8
9	247.0	96.2
60	252.8	97.4

Actual (1961 = 100)·Index

1961	100.0	1966	105.0	1971	123.8
2	100.9	7	106.4	2	128.4
3	100.9	8	111.1	3	131.5
4	103.0	9	114.0	4	147.9
5	103.9	70	117.9		

* Average of available monthly indexes; therefore should be considered as an approximate.

APPENDIX D

SELECTED CHARACTERISTICS OF CUSTOM TRUCKERS

TABLE I-D.1

TRUCK BASED CHARACTERISTICS

Characteristics (Average per Truck)	Unit	Value
Size of Truck	Tons	3.038
Capacity of Grain Box	Bu.	387.7
Annual Mileage	Miles	12,433
Annual Bushels Hauled	Bu.	27,558
Distance to Elevator	Miles	36.9
Weighted Delivery Distance	Miles	55.4
Age of Truck	Years	8.85
Bushel-Miles		1,527,575

TABLE I-D.2

DISTRIBUTION OF TOTAL COST OF TRANSPORTING GRAIN FOR A CUSTOM TRUCKER, 1974

Cost Item	Value For 1974	Percent of Total Cost
Depreciation	$ 449.46	14.2
Housing	33.15	1.0
Interest	247.08	7.8
License & Insurance	111.06	3.5
Common (Fixed) Costs	840.77	26.5
Tires & Battery	282.49	8.9
Upkeep & Repairs	369.19	11.6
Common (Variable) Costs	651.70	20.5
Fuel Cost	806.04	25.5
Deadhaul Labour	372.82	11.7
Driving Labour	502.18	15.8
Direct Costs	1,681.04	53.0
Total Cost	3,173.51	100.0

TABLE I-D.3

AVERAGE COST OF TRANSPORTING GRAIN FOR A CUSTOM TRUCKER, 1974

Average Cost Per Bushel	11.51
Average Cost Per Bushel-Mile	.208

CHAPTER 2

ROAD COSTS

W.A. Scott

INTRODUCTION

An estimation of road costs assignable to increased trucking brought about by rail line abandonment is important for purposes of:

1) overall cost analysis of system alternatives;
2) determination of changes in the distribution of costs.

The following considerations are illustrative of the factors which contribute to the complexity of speculative road cost determination and assignment:

1) Routing and amount of grain traffic;
2) Make up of traffic as to vehicle description;
3) Timing and concentration of traffic;
4) Effect of predetermined traffic volume and type on road surface affecting specification and/or maintenance required;
5) Variations in costs of construction and maintenance tasks given different authorities and locations;
6) Future public demand for improved roads.

Provincial and municipal presentations to the Commission have highlighted road costs because of the potential transfer of costs from federal to local authorities in the event of rail line abandonment. No standard format has been used in the compilation of briefs on the subject and it is difficult to relate the content of one presentation to another. In view of the complexity and judgment required in calculating projected road costs, it is essential that the various briefs be summarized and reviewed in the light of research which has been carried out in the area of road impact.

PURPOSE

This chapter will outline the approaches and condense the claims which have been made in presentation to the Commission on the topic.

Discussion will relate the results of various research studies under topical headings dealing with the key objectives and technical problems of analysis.

Conclusions will be drawn with regard to the order of magnitude of future road costs assignable to rationalization and the need for further discussion or analysis.

EXECUTIVE SUMMARY AND CONCLUSIONS

The estimation of potential road cost increases resulting from the impending abandonment of rail lines is complex in that a wide array of assumptions must be made. These assumptions begin with a decision regarding the basic concept of delivery point spacing or location for purposes of projecting traffic routes and volume. Determination of road specifications and life of surfaces and subgrades goes beyond the simple application of engineering strength of material principles. Much input data for use in the engineering analysis is based on somewhat arbitrary selection of factors such as vehicle description (truck size), timing and concentration of traffic and experience factors reflecting typical roadbed performance.

Submissions on the subject of road costs by the Provinces of

Alberta and Saskatchewan have presented total cost estimates to allow for construction and extra maintenance resulting from line by line analysis of road impact which might take place in the event of abandonment. The Province of Manitoba simply related total provincial road mileage to railroad mileage to determine a ratio which was then used to calculate the corresponding number of miles of road which would be affected with abandonment of all category II rail lines.

If one were to accept the blanket abandonment case as "the solution" across the system, the total costs for Saskatchewan would seem low with respect to the Alberta costs, and the total costs for Manitoba would appear high considering the simplistic notion of complete Category II rail line abandonment. When compared with earlier Saskatchewan research, however, the provincial estimates are high and in further testing the Alberta methodology against other research and theory application, the estimates of the Alberta submission would also appear conservative (or high). The Canada Grains Council figures from the Brandon area study are based on more rigorous analysis and they provide costs in cents per bushel based on more realistic methodology than does the recent Manitoba government brief.

Translation of the gross road costs into costs related to the hauling of an average bushel of grain is helpful in relating road impact to the total grain handling and transportation system. The following table summarizes the costs presented by the provincial governments. Estimates from the Canada Grains Council Brandon area

study are also shown:

Province	Additional Annual Cost of Road Network	Additional cost of roads in ¢/bu. for grain handled on Category II lines	Additional cost of roads in ¢/bu. for grain handled on all lines
Alberta (1,473 miles of Category II lines)	$2,230,000	4.6	1.1
Saskatchewan (3,470 miles of Category II lines)	4,770,000	3.0	1.1
Manitoba (1,341 miles of Category II lines)	Not Estimated	--	--
Canada Grains Council - Brandon Area	258,000*	3.3	0.9

* 1973 study costs

Given the wide range of assumptions beginning with the definition of the change in delivery point location and spacing, it is not likely productive to re-hash figures submitted. One must recognize the possibility that the most objective estimates would necessarily be submitted with a broad range of totals, the appropriate figure would then be chosen based on selection of dozens of criteria allowed for within the range. When the wide variation in public reaction and demand is combined with the other complexities, it is conceivable that different parties even though they might be quite technically oriented may not be able to agree on even the order of magnitude of road cost

assignable to grain haul.

At this point, one might gain perspective by comparing road costs in the order of one cent per bushel which have been submitted by the provinces with the costs of other components of the system. For example, the railways have suggested that the present statutory freight rate of about 12 cents per bushel may be in the order of three and one-half to four times too low. This means that a compensatory rate would be 42 cents to 48 cents per bushel. Even after detailed consideration of all the operating costs, it is conceivable that the marginal error in calculation of this one component will in itself account for funds in excess of total additional highway expenditures.

It would appear that additional highway costs resulting from rail abandonment and "foreseeable" rationalization will not form a significant portion of the total cost of handling and transporting grain. The significance of the projected highway costs to the provinces, however, is illustrated by the fact that the level of annual expenditures required to compensate for their estimated increases account for 2, 6, and 14 percent* of the highways maintenance and construction budgets for Alberta, Saskatchewan and Manitoba respectively.

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* An approximation only -- see appendix for derivation.

DISCUSSION

SUBMISSIONS TO THE COMMISSION

The following summaries paraphrase the main points gleaned from some of the provincial and municipal briefs. Unit construction and maintenance costs as presented have been compiled and are contained in the appendix of this report. Comparison or critique of the submissions will be reserved for other sections of this discussion which draw together the various facets of briefs under topical headings.

Province of Alberta

Three briefs presented by Alberta Transportation Department (October 1975, June 1976 and September 1976) contained summaries of detailed calculations which had been carried out in the estimation of additional costs which would be incurred over a 20-year period in the event of abandonment of Category II rail subdivisions.

It was recognized that larger trucks can haul a quantity of grain with fewer equivalent load units and less resultant damage to roads than if the same quantity of grain were moved by smaller trucks. For example, a two-axle three-ton truck carrying 286 bushels per trip will subject the roadway to about 2.25 times as much stress as will a five-axle semi carrying 964 bushels per trip.

Each "subdivision cost increase" was calculated for two basic assumptions: off-line elevator operation and direct producer haul to on-line elevation points. It was recognized that in the majority

of cases the concentration of traffic resulting from commercial hauling to the on-line point from the off-line elevator would result in higher road cost increases than would the more dispersed farm truck traffic flow directly to the on-line point.

The total cost of additional grain haul traffic given abandonment of all red lines in Alberta would be 44.8 million dollars to be spent over a 20-year period. Abandonment of the Furness subdivision, for example, would result in an expenditure of about 1.2 million dollars over a 20-year period considering the road impact of commercial trucking from an off-line elevator at Paradise Valley.

Province of Saskatchewan

This brief recognized the contradiction in the "need" for a hard or oil surfaced road with increased truck traffic. That is, a gravel road will handle more trucks at less cost than an oil surfaced road. Thus, if increased truck traffic results in a need for a hard surface, it may be necessary to go for a higher quality surface to retain the other benefits of hard surface.

The Saskatchewan Department of Highways estimated the impact due to diversion of grain caused by abandonment. No two adjacent lines were assumed to be abandoned simultaneously. Haul was assumed to be in 250-bushel trucks over a 200-day year and costs calculated over a 15-year time frame amounted to 62 million dollars.

There is an admitted problem of determining the road standards required in estimating the impact of additional traffic. The major

impact was on oiled or low quality paved roads. Only a minor mileage of gravel roads were estimated to need oiling although it is expected that strong pressure for dust free surfaces would result from only modest increases in truck traffic due to abandonment.

From the standpoint of the public, it would be ideal to overcome the problems created by additional truck traffic by upgrading gravel roads to an asphalt standard and to improve oiled roads to a paved standard. At a cost of about $80 thousand per mile to improve gravel roads and $160 thousand per mile to improve oiled roads, the cost of the above assumed abandonments would be about $500 million.

In the event of large inland terminals replacing the present elevator system, the impact of extra hauling, larger trucks and higher speeds would be disastrous. The brief further states that the upgrading required would cost a total of more than 2.25 billion dollars.

Saskatchewan Municipalities

The Saskatchewan Association of Rural Municipalities projected the costs which might be added to road construction and maintenance in the event of abandonment of the Chelan and Wood Mountain subdivisions.

For example, abandonment of the Chelan subdivision would require movement of four thousand truck loads over four grid roads at one thousand truck loads per year (500 bushels each). It was assumed that this traffic would cause a 25 percent reduction in the road "life" and that yearly maintenance and regravelling costs would increase by 25 to 30 percent. This would result in a yearly cost increase of

about $450 per mile per year as follows:

Maintenance cost increase.....	$ 250	x 30% =	$ 75.00
Regravelling cost increase ...	225	x 30% =	67.50
Construction cost increase ...	18000/15	x 25% =	300.00
Total			$442.50

It was estimated that if the road surface were oiled, the required maintenance of $1 thousand per year would increase by 50 percent for an extra $500 per year.

The R.M. of Enfield submission at the Central Butte hearing presented possible cost increases on certain sections of grid road which would receive the largest increase in truck traffic in the event of rail line abandonment. Present maintenance and regravelling appeared as follows:

Grid and main fram access roads:

Maintenance, 1975	$ 235.00/mi.
Gravel - 250 cu.yd. per mile applied every three years at $1.50/yd. and $1.75/yd. to haul ($3.25/yd.)	270.00/mi.
Total Yearly	$ 505.00/mi.

For the sections or road which would require regravelling every two years under increased traffic instead of every three years, the total cost increase would be $90 to $180 per mile per year.

Province of Manitoba

Construction would be required to upgrade many roads to 74 thousand pound capacity in the event of abandonment. Municipalities in the province have indicated costs for minimum standard gravel roads

of $2 thousand to $6 thousand per mile to handle the additional grain haul traffic.

The province expresses the opinion that the munipal estimates are conservative and that minimum upgrading costs on municipal roads would be approximately $15 thousand to $20 thousand per mile.

Manitoba recognized a simple ratio of 10.5 miles of road per mile of railway in the province. It was reasoned that this results in a possible 7,600 miles of road being affected in the event of abandonment of 727 miles of railway. An amount of $41.8 million would be required to upgrade 7,600 miles of road if the municipal estimates are assumed correct or $93.7 million if the $15 thousand per mile figure were used.

ROAD IMPACT RESEARCH

The 1971 Grains Group Report outlined several systems which might be derived for the collection of prairie grain. Proposals did not estimate road costs associated with the various schemes although they did create a basis for discussion of potential traffic patterns and perhaps provided the impetus for the generation of various research projects on the topic of road impact.

Some research had been initiated by municipal and provincial governments prior to the Grains Group Report. This can now be combined with more recent studies as a basis for evaluating the claims of local and provincial governments.

Routing and Amount of Grain Traffic

An Assumption regarding spacing of collection points is the most critical element in assessment of road impact. This is illustrated by the relationship developed by Shurson* which showed that traffic varies with the square of the distance between collection points. Surson demonstrated by theoretical shed areas that main links in the road network would be subject to significant increases in traffic volumes in the event of a major change, however, centralization in which spacing of collection points was 20 miles or less would affect only the maintenance cost of rural roads.

Shurson further deduced that centralization in which spacing of collection points was in the order of 20 miles would result in decreasing the number of collection points in Saskatchewan to approximately 520. In 1975 Saskatchewan Pool were represented at about 90 percent of the delivery points in the province (i.e. 715 out of 796). Over the next ten year period, they estimate that this figure would decrease by about 165 to 550** stations. Assuming a similar trend at "non-Sask. Pool" points in the province, the total number of delivery points in the province would, in fact, be reduced to about 600.

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* Shurson, Gordon W. A Study of a Rationalized Grain Handling on the Roads and Highways of Saskatchewan, an unpublished M. Sc. Thesis, Dept. of Civil Engineering, U. of S. Saskatoon, July, 1972.

** Saskatchewan Wheat Pool final submission to the Grain Handling and Transportation Commission at Saskatoon.

As a very rough tie in with the Shurson theory regarding traffic volumes, it might be concluded that the system, in the absence of large scale centralization, would result in overall collection point spacings averaging less than 20 miles, a change not likely to result in significant increases in traffic on major road links.

The analysis by Shurson, referred to above, dealt largely with the increase of traffic on main links and it concluded that the increase in levels of traffic on secondary roads would be relatively insignificant. It was recognized that secondary routes near the extremities of the shed areas would receive significantly more traffic than those routes of similar classification located near the collection point. A study compiled in 1969 by the Saskatchewan Municipal Road Assistance Authority* serves to complement the work by Shurson. This study considered the impact on all roads in the event of abandonment of the Colony subdivision (Rockglen-Killdeer area).

Whereas the Shurson analysis considered theoretical traffic assignment and related this to the provincial road network, the Municipal Road Assistance Authority report was based on actual survey of the detailed road pattern in a smaller area. Information was obtained on the number of grain hauling trips made per year before abandonment (five year average), the routes used and the number of grain hauling trips that would be made and the routes that would be used to haul

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* Clampitt, H.A. and J.J. Kovach, A Study of Effects of Railway Abandonment on Rural Road Needs in the Rockglen-Killdeer area. Municipal Road Assistance Authority, Regina, 1969.

this grain to the new point. The largest projected increase in grain hauling was immediately adjacent to Rock Glen on Highway No. 2 where the resultant average grain haul traffic would have amounted to ten vehicles per day. This figure was small compared with the total traffic consisting of 240 vehicles per day formerly carried by this highway. The total increase in daily traffic on the main grid road from Killdeer to Wood Mountain would have been one vehicle per day average. This figure was also low compared to the volume of 50 to 100 vehicles per day normally carried by this road. These results led to the conclusion that the increase in daily traffic due to railway abandonment would have been relatively insignificant compared to other traffic on the roads. It was stated that other studies which had been carried out by the Municipal Road Assistance Authority verified these results in that grain hauling traffic averaged about three percent of the total traffic on grid roads in the province.

Make-Up of Traffic as to Vehicle Description

Highway use is often expressed in terms of average annual daily traffic (AADT). This is simply a count of the total number of vehicles per year of all descriptions which pass a given point from both directions divided by 365 days. The count of vehicles is usually broken down into total traffic and number of trucks since the effect of the heavier loads is a significant factor in the life of a road. Truck traffic normally represents in the order of 10 percent to 20 percent of total traffic. For example, the Canada Grains Council*

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* Canada Grains Council, Brandon Area Study Committee, The Grain Handling and Transportation System in the Brandon Area. Canada Grains Council, 1974.

listed truck traffic over a number of roads in Manitoba ranging from 5 to 14 percent total and Shurson recorded 1971 truck volumes on selected highways in Saskatchewan ranging from 11 to 27 percent of total. A more definitive measure of traffic from the standpoint of road bed and road surface deterioration has been developed based on the actual weight and number of axles which pass over a section of road. The unit derived and in common use is referred to as an equivalent 18 kip (18 thousand pound) axle load and a cross referencing system has been set up which allows for the expression of any vehicle weight and axle combination in terms of ESAL's. One unit or one ESAL (Equivalent Single Axle Load) then is equivalent to one axle loaded to 18 thousand pounds. A single pass with a 750 bushel truck will subject a road to 2.125 ESAL's, whereas, a 200 bushel truck will subject the road to 1.125 ESAL's. A 200 bushel truck must make 3.75 trips in order to move the same quantity of grain as a 750 bushel truck. The 3.75 trips of a 200 bushel truck would subject a roadbed to 4.22 ESAL's or approximately twice the stress of one trip with the 750 bushel truck.

From the above discussion, it is apparent that an assumption of a certain average truck size or mixture of truck sizes must be made in order to provide detailed data required for the assessment of road impact due to increased grain movement over highways in the event of centralization. The most conservative (i.e. resulting in greatest impact) would be to assume that the average truck size remains about the same as present. This is the method which was adopted by

the Saskatchewan Municipal Road Assistance Authority in the study of road impact in the Rockglen - Killdeer area. Most studies which have considered centralization beyond the immediate area have reasoned that truck sizes will increase as distance to haul increases. For example, Shurson used farm trucking costs as compared to commercial rates to justify the assumption of 750 bushel trucks in larger area centralization. An internal study by the Saskatchewan Department of Highways* assumed that 25 percent of the grain would move in 250 bushel trucks and the remainder would move in 918 bushel trucks. This latter study also concerned itself with larger area centralization in that it was assumed that the grain collection system would consist of only 42 delivery points in the Province.

It is important to note the number of assumptions which must be made in order to derive a basis for relating the traffic volume increase as a result of centralization to the existing traffic volume. The Canada Grains Council was faced with an interesting situation, for example, in the Brandon Area Study. Information was not available as to the existing truck traffic on a number of roads which would be affected in the area. It was recognized that higher class roads were normally traversed by a larger average truck size. Therefore, a truck size was assumed for each road class; this average truck factor also included a component to represent the return or empty truck.

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* Platta, J.B. The Impact of an Inland Terminal Scheme of Grain Handling Rural Roads and Highways in The Province of Saskatchewan. Planning Branch Department of Highways and Transportation, February, 1973.

In order to calculate the basic equivalent load units, a further assumption was made to the effect that truck traffic on some roads prior to option changes would represent 10 percent of the total vehicle count. A range of normal traffic loading was then calculated for each class of road based on existing total traffic counts. The extremities of these ranges were used as boundaries for the determination of upgrading required when additional grain haul traffic equivalent load units were added to existing traffic load units which had been calculated for a specific section of road.

Additional truck traffic due to grain haul will normally be uni-directional insofar as the heavily loaded movement is concerned. It has been pointed out by Shurson that when comparisons of existing and future traffic are used to assess impact, the effect of uni-directional hauling must be considered. This means that on laned highways either the existing traffic load figures might be considered equal to one-half of total or else the additional traffic figures should be doubled.

Timing and Concentration of Traffic

Oil treatment surfaces are particularly sensitive to heavy axle loads during the spring months of the year when thawing occurs. To a lesser extent,paved roads may experience higher failure rates also due to the thawing of "ice pockets" which have been formed by capillary action in the subgrade during the freezing process. Weight restrictions are, therefore, imposed on a number of roads over the

spring months. Restricted roads, inclement weather, timing of farm operations and elevator space tend to combine and have the effect of confining high volumes of grain movement to the months of June and July.

Oil surfaced and gravel roads may sustain different levels of annual traffic depending on the concentration of this traffic. The ideal situation of uniform levels of traffic throughout the year creates the opportunity for maximum use of the roads within acceptable limits of deterioration. This is due to the fact that less frequent loading of the surface over a short period of time decreases the tendency for chuck holes to form and results in more uniform maintenance intervals with respect to the number of vehicles. In order to allow for the effects of high frequency of loading during peak periods, it is appropriate to consider these peaks in relation to normal daily traffic levels for specific roads in assessing impact. The internal study by the Saskatchewan Department of Highways, for example, calculated daily commercial truck traffic on the basis of a 220-day hauling year; a more conservative estimate for farm to elevator haul might be based on a consideration of 40 percent of the grain traffic moving during a two-month period.

The Effect of Additional Traffic Volume and Traffic Make-Up on Road Specifications

Added highway use would normally be assessed in terms of the increase in AADT (average annual daily traffic) with a further check to determine if it was expected that there would be a significant

change in traffic composition. For purposes of appraising the effect of increased grain movement, most research is oriented toward assessment of road impact based on load units expressed in terms of equivalent single axle loads (18 thousand pounds) and the change in total traffic receives secondary consideration.

The life of a pavement structure is almost directly proportional to the increase in load units. The effect on an oiled or gravel surface road is much less predictable and is more subject to immediate damage as a result of load increases.

The most practical means of assessing the impact of increased traffic is to compare existing and potential traffic on the route in question with historical data which is available for a number of roads located within the same jurisdiction. Shurson summarized the historical data which was available for a number of roads in Saskatchewan. It was found that Saskatchewan roads have not been considered for upgrading from oil to pavement until total traffic movements reach the equivalent of 35 to 50 ESAL's per day and oiled surface roads carried between 15 and 80 ESAL's per day. Highways carrying less than 35 ESAL's per day could sustain this level of axle loading on an oil surface with normal maintenance. It was concluded that the range of 50 to 60 ESAL's could be used as a guideline and reference point in determining whether or not the estimated increase in axle load repetitions would be significant.

The effect of different levels of centralization on traffic volumes was outlined by Shurson as mentioned in a previous section of

this discussion under "Routing and Amount of Traffic", it was found that collection point spacing in the order of 20 miles would not appear to have a significant effect. It was expected, however, that 20 or more ESAL's would be added to 60 percent of the major route mileage for collection point spacing in excess of about 45 miles. Shurson recognized that the major link weakness in the event of development of such a centralized system would be the oil surfaced roads and he stated that the addition of 20 or more ESAL's per day to some existing oil treatment surfaces would probably require the reconstruction of the oil treatment to a heavy duty pavement standard.

The internal Saskatchewan Department of Highways' research considered a total of only 42 delivery points in the province. It was found that the major requirement for funds came about as a result of necessary upgrading of oil surfaced roads to pavement. A pavement structure was deemed necessary if total daily 18 kip ESAL's exceeded 25. This study assumed that increases in AADT would have zero effect (i.e. the effect was reduced simply to consideration of increases in ESAL's with no consideration being given to the increase in number of vehicles using the road).

The method of quantifying increases in road loading used by Canada Grains Council in the Brandon study was outlined in an earlier part of this discussion dealing with traffic make-up. The upper "boundary" of traffic which would be acceptable on the lowest class of "oiled road" (6"Asphalt Surface Treatment) was 13,678 ESAL's per year or an average of 38 applications per day. This study also

considered factors other than increases in ESAL's. For example, the section of Provincial Road 254 was assumed "too narrow to facilitate commercial trucks of 74 thousand pounds" and there was an allowance of $30 thousand per mile for the upgrading of nine miles of this road to handle a total of 357 trucks per year.

COSTS OF ROAD CONSTRUCTION AND MAINTENANCE ASSIGNABLE TO RAIL ABANDONMENT

Alberta

The Alberta Transportation submissions have been reviewed for purposes of assessing the validity of increased road cost figures. It was determined that the off-line operation of an elevator at Paradise Valley (see Appendix) would not result in a requirement for upgrading the oiled surface section of road on the route to Edgerton since over a critical two month peak period the total increase in load would be about 14 ESAL's.

If it was assumed that the increased traffic reduced the normal resurfacing interval from six to four years application of unit costs presented by Alberta Transportation would increase the average annual expenditure by about $700 per mile, whereas, the Alberta submission indicates that there was an allowance equivalent to about $2,400. per mile for this case in estimating the provincial totals.

This example illustrates that the Alberta Government estimate of extra annual expenditures of $44.8 million over a twenty year

period is likely based upon assumptions which make ample allowance for increased road requirement in anticipation of abandonment of all Category II branch lines.

Saskatchewan

The internal report prepared by the Saskatchewan Department of Highways in 1973 claimed to be conservative in that municipal roads were not really subject to capital cost increases under the methodology used. This study which assumed only 42 delivery points in the province estimated that the effect of this level of centralization would result in a requirement of $126 million capital expenditure and about $3 million additional maintenance per year.

The Municipal Authority study for the Rockglen - Killdeer area based on an actual survey concluded that the additional maintenance costs on the roads due to railway abandonment would be practically impossible to measure; however, due to the relatively low increase in average daily traffic, it was suggested that the costs would be relatively insignificant. In this study, analysis of traffic was carried out immediately after a quota was opened. This led to the conclusion that even peak grain hauling traffic would not tax the capacity of the road system either before or after abandonment. Considering the normal timing of grain traffic haul (when weather is good and roads are not soft) and the short periods of peak traffic, it was stated that larger and more costly roads would not likely be necessary or justified as a result of an increase in the number of

larger trucks in the event of rail abandonment. It was further noted that all weather roads are required whether or not the railways are abandoned and the planned networks, when constructed, will generally be adequate to carry re-oriented or increased grain traffic if a railway is abandoned.

In view of the lower level of centralization considered in the Saskatchewan government submission, the $62 million figure seems high compared to the 1973 internal report total of $126 million plus $3 million annual maintenance. One would expect, however, that the Saskatchewan total would be much higher than the Alberta figure of $44.8 million considering the geography and the relative number and mileages of Category II branch lines within each province.

Manitoba

The methodology used by the Manitoba government might be generously described as "the broad brush treatment". Ratioing mileages of railroad to miles of roads and highways totals in the provinces would appear to be a very simplistic approach to the assessment of traffic increases and road impact in the event of abandonment.

The 1973 analysis by the Canada Grains Council in the Brandon area is relatively rigorous. The requirement for upgrading and subsequent costs of construction and maintenance were based on movement of grain from off-line elevators in the case of discontinued rail service. It would appear that conservative approaches were used in the assessment of road impact as illustrated by the example previously

mentioned where nine miles of Provincial Road #254 were slated for upgrading at a cost of $30 thousand per mile. This resulted in an annual cost of $25,803 or $2,867 per mile for maintenance and construction costs to handle 354 trucks per year.

A total of about $258 thousand per year would be required to cover the maintenance and construction costs assignable to additional grain traffic in the Brandon area according to the above analysis. The rationalization scheme which was assumed in the study encompassed an area which delivered about 28.3 million bushels of grain for rail movement during the study year. The increased road costs therefore resulted in an average of about 0.91 cents per bushel. Due to the complexities of analysis and the wide range of assumptions required to perform calculations, the study did not detail estimates of highway costs which would result from producer haul to on-line elevators, however, it was assumed that this would result in a lower total mileage of collector roads being affected and a total cost of about one-third cent per bushel (or one cent per bushel over the 7.7 million bushels requiring additional trucking) was assigned for this alternative).

INTERPRETATION OF COSTS CLAIMED AND RELATIONSHIP OF ROAD IMPACT TO THE GRAIN HANDLING AND TRANSPORTATION SYSTEM

Estimation of road impact and costs resulting from increases in grain truck traffic as a result of removal of rail service and attendent centralization is very complex. Any approach to cost

anaysis for an area necessarily involves the researcher in a series of assumptions. As the boundaries of the geographical area under consideration are widened, several more assumptions must be stacked upon the arbitrary factors chosen in analysis of a smaller area.

Estimates of the Alberta and Saskatchewan government appear to be based on a fairly rigorous analysis in spite of the fact that the choice of methodology might be questioned from many different viewpoints. A number of examples of possible off-line elevator operations have been analysed. These examples (Appendix) provide some insight into road impact in terms of increased loading on major routes. Results would indicate that the Alberta and Saskatchewan government estimates tend to be conservative (i.e. high) as shown for example in the case of earlier discussion with regard to the Furness subdivision example at Paradise Valley.

Public demand must be anticipated in the estimation of road costs but the assessment of that portion attributable to removal of rail service is further complicated by the difficulty of relating cause and effect. For example, there may be many cases where the most practical and lowest cost road specification from the standpoint of the grain haul is not compatible with the requirement of other traffic. Suppose that two points were now connected by a gravel road, since a gravel road might be less costly to maintain than an oiled surface road under higher volumes of truck traffic, the optimum specification might be to stay with a gravel road. As time goes by, the expectations of the public may rise and road standards predictabley could be

raised to "dust free" even under conditions of decreasing total traffic. This might necessitate a change to an oiled road which is more subject to costly damage from a relatively low volume of untimely truck traffic. This type of situation is eluded to in the Saskatchewan government statement: "It is expected that strong pressure for dust free surfaces will result from only modest increases in truck traffic due to abandonment". Given the wide range of assumptions beginning with the definition of the change in delivery point location and spacing, it is not likely productive to re-hash figures submitted. One must recognize the possibility that the most objective estimates would necessarily be submitted with a broad range of totals, the appropriate figure would then be chosen based on selection of dozens of criteria allowed for within the range.

Increases in Road Costs Related to Grain Delivered

The provincial estimates have been reviewed and translated into average annual costs as shown in the Appendix. The resultant figures are labelled "1975 constant dollar annual costs" as the provincial government allowances for inflation have been removed. Average annual grain deliveries have been totalled for all Category II branch lines and for all rail lines in Alberta, Saskatchewan and Manitoba. The Saskatchewan government estimate of increased road costs due to line by line abandonment when divided by the grain delivered to these Category II branch lines results in a cost of about three cents per bushel and when divided by all grain delivered in the province, the

cost would be about 1.1 cents per bushel. Similarly the results of spreading the Alberta government cost estimate over branch line grain is about 4.6 cents per bushel and over all grain would be about 1.1 cents per bushel.

The Manitoba government estimate of $41.8 million or $93.7 million does not lend itself to similar interpretation as there is not sufficient information in the submission to interpret the figures in terms of total annual costs consisting of amortized construction plus annual maintenance. The Brandon area study, however, involved a detailed analysis of an area collection system which handled about one-quarter of the grain delivered in the province. This detailed calculation resulted in assignable extra road costs of 0.9 cents per bushel for all grain delivered.

It has been illustrated that provincial estimates of increases in road costs due to centralization resulting from rail branch line closure are in the order of three cents per bushel for grain movement affected and amount to about one cent per bushel over all grain delivered. These are average cost figures and should not be interpreted to mean that such figures can be simply applied in the calculation of additional road costs for a micro-rationalization study. Proper assessment of potential road cost increases for purposes of comparing alternatives is still dependent on detailed traffic and road cost estimates in area analysis. The Canada Grains Council Brandon Area Study highway cost increases were estimated in detail; however, it might be argued that even within this area, optimization would be

dependent upon a breakdown into finer geographical segments.

Increases in Road Costs Related to Total Highway Expenditures

When viewed in the light of costs of other components of the grain handling and transportation system, one to three cents per bushel to cover additional road costs may not be difficult to justify. In fact, decisions to change and optimize within a well defined collection area may be based on recognition of increased road costs far exceeding the three cents per bushel figure. Resistance to rationalization in cases where the overall economics of change "make sense" may exist chiefly because of potential transfer of costs between jurisdictions. The appendix of this report contains a summary of provincial highway expenditures. The significance of changes in the grain gathering system as viewed by the provincial governments is illustrated by the fact that increases in road costs estimated amount to about 2, 6 and 14 percent*of current highway budgets for Alberta, Saskatchewan and Manitoba respectively.

The Brandon Area Study recognized the potential increase in government revenues which would tend to offset costs. In this analysis, license fees and fuel tax amounted to about one-quarter of a cent per bushel to offset road cost increases of about three and one-third cents per bushel for grain moved by truck in place of rail.

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* The Manitoba figure is based on an approximation in an attempt to relate an expenditure of $93.7 million to existing expenditures -- see Appendix.

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ROAD MAINTENANCE AND CONSTRUCTION COSTS

MANITOBA

ROAD TYPE	Source of Information	Cost of Complete Construction	Next Lower Road Standard	Cost of Upgrading from next lower standard	Nature of Maintenance	Total Annual Maintenance Cost
'75 Gravel 28'	Province of Manitoba	45,000 to 70,000				
'75 Asphalt 28	Province of Manitoba	120,000 to 170,000				
'73 Asphalt	Canada Grains Council				Surface	150 - 570
'73 Gravel	Canada Grains Council				Surface	500 - 680

ROAD MAINTENANCE AND CONSTRUCTION COSTS

ALBERTA

Road Type	Source of Information	Cost of Complete Construction	Next Lower Road Standard	Cost of Upgrading From Next Lower Standard	Nature of Maintenance	Total Annual Maintenance Cost
'75 Gravel 24'	Province of Alberta	40,000				900
'75 Gravel 24'	Province of Alberta		Good road for reconstruction	15,000		
'75 oiled 24'	Province of Alberta	49,000				
'75 Pavement 28' (5" to 12" plant mix)	Province of Alberta		Gravel 28'	90,000 to 214,000		300

ROAD MAINTENANCE AND CONSTRUCTION COSTS

SASKATCHEWAN

Year of Cost & Road Type	Source of Information	Cost of Complete Construction	Next Lower Road Standard	Cost of upgrading from next lower standard ($/mi.)	Nature of Maintenance	Total Annual Maintenance Cost($/yr/mi)
'73 Farm Access Gravel	R.M. of Enfield	$ 5,000				
'74 Farm Access Gravel	R.M. of Enfield	10,000				
'75 Farm Access Gravel	R.M. of Enfield	11,000 to 13,000				
'75 Grid Gravel (24')	R.M. of Enfield				maintenance $235 regravel $270	$ 505.00
'75 Grid Gravel (24')	Saskatchewan Association of R.M.'s	18,000			maintain $250 regravel 225	475.00
'75 Grid Oiled (24')	"					1,000.00 - 1,500
'75 Grid Gravel (24')	Sask. Municipal Road Assistance Authority	13,000				
'75 Grid Asphalt 24' (2"-3" asphalt)	"	28,000				
'75 Gravel 28'	Province of Sask		Earth	$ 27,000		3,700
'75 Oiled 28' (3/4" asphalt)	Province of Sask.		Gravel 24'	14,000		
'75 Asphalt 28' (2" asphalt)	Province of Sask.		Gravel 28'	30,000 to 80,000		3,000
'75 Pavement 28' (4" plant mix)	Province of Sask.		Oiled	60,000 to 160,000		2,600

A P P E N D I X

ANALYSIS OF ROAD IMPACT IN THE EVENT OF ABANDONMENT OF THE FURNESS SUBDIVISION BASED ON INFORMATION CONTAINED IN THE SUBMISSION TO THE COMMISSION BY ALBERTA TRANSPORTATION DEPARTMENT AT THE REGIONAL HEARING IN STETTLER, ALBERTA
June 14, 1976

The following analysis picks up on statements regarding the Furness subdivision and provides some insight into the per mile expenditures used by Alberta Transportation.

In the case of the Furness subdivision, Table 3 lists the total costs at $1,148,000 over a 20 year period for extra road expense due to abandonment and operation of the Paradise Valley elevators as off-line facilities. The "present worth of costs" figure of $806,500 in Table 4 serve no serious purpose but it would be meaningful to calculate a conventional present value for the expenditure of $1,148,000 over 20 years and to also indicate what would be the equivalent average annual amount.

1. Annual costs estimated from figures presented in submissions

Assuming an effective interest rate* of 1.85 percent and equal amounts, the $860,500 "present worth of costs" figure would require the commitment of $51,866 in each year over the 20 year period. The present value of this commitment at the 10 percent discount rate would be $441,564. This equivalent annual expenditure

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* This is approximately equivalent to the Alberta Transportation use of eight percent inflation and a ten percent interest rate. This also checks approximately with the total expenditures figure of table 3 (i.e. $\frac{1,148,000}{20}$ = $57,400 per year).

of $51,866 is now useful in assessing the reasonableness of Alberta Transportation's statements regarding the extra cost of road impact due to abandonment.

2. Projected additional traffic due to "off-track elevator" operation

Paradise Valley Receipts are approximately 600 thousand bushels per year. Assume that for purposes of road impact one must allow for peak traffic volumes thereby 40 percent of the grain moves during the months of June and July, i.e. two months at 120 thousand bushels per month.

To move this on a single shift basis and a five-day week at 900 bushels per trip equals 133 trips.

This works out to about six trips* per day during the peak period.

3. Road Impact

There are several ways of relating this added traffic density to road impact:

a) One might look at the increase in E.S.A.L.'s (Equivalent single axle loads) and compare this increase with normal total E.S.A.L.'s for various road specifications. Each trip with a five-axle-semi loaded to 900 bushels will subject the road to about 2.4 ESAL's. The total increase in ESAL's over the critical peak period will be 2.4 x 6 = 14.4 per day.

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* 52 x 1/12 x 5 = 22 working days per month
133 ÷ 22 is approximately equal to 6.

Historically, Saskatchewan roads have not been considered for upgrading from oil to pavement until total traffic movements reach the equivalent of 35 to 50 ESAL's per day and oiled surface roads currently carry between 15 and 80 ESAL's per day.* Highways carrying less than 35 ESAL's per day could sustain this level of axle loading on an oil surface with normal maintenance. The range of 50 to 60 ESAL's can be used as a guideline and reference point in deciding whether or not the estimated increase in axle load repetitions will be significant. Considering this information, it is unlikely that an increase of 14.4 ESAL's over a peak period would have much effect on the upkeep of an oiled road. It would also be implausible to assess a very significant portion of the cost of upgrading to this additional loading.

b) The additional truck traffic might be compared with total traffic and normal traffic mix relative to road specification.

Saskathcewan Department of Highway criteria requires 500 to 600 units per day to justify upgrading from an oiled surface to pavement.** Truck traffic would normally be

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* A Study of a Rationalized Grain Handling Industry on the Roads and Highways of Saskatchewan, Gordon W. Shurson, Unpublished M.Sc. thesis University of Saskatchewan.

** CP Rail Line Relocation - Poplar River Project, Sask. Power Corp.; a report forwarded to the Commission by W.H. Horner Executive Advisor Grain Handling and Transportation System Rationalization Prov. of Sask.

approximately equal to 10 percent of the total. Therefore truck traffic would be in the range of 50 to 60 units per day at the point of upgrading.

A large five-axle semi could be considered equivalent to about two average trucks for each round trip in grain haul.

It can be seen that on this basis, six trips per day would likely account for a relatively low percentage $\left(\frac{6 \times 2}{60} = 20 \text{ percent}\right)$ of the total contribution of truck traffic toward requirement of an upgrading of the road from oiled surface to pavement.

4. <u>Assessment of annual highway costs attributable to extra grain haul traffic</u>

The route (see circled area on attached map) from Paradise Valley to Edgerton* is made up of about eight miles of gravel and seven miles of oil surface treatment (improved road #897) combined with four miles of heavy duty pavement (highway #41) and seven miles of asphaltic surface course (highway #894).

Road impact and resultant cost might be considered with respect to each section as follows:

a) Additional grain haul from Paradise Valley would have a negligible effect on the life of the heavy duty pavement section;

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* There are approximate mileages and specifications determined from provincial highway maps.

b) The oil surface gravel and asphaltic surface course road sections total 22 miles.

Therefore, the Alberta Transportation submission would indicate that there is an allowance of about $2,400 per mile for yearly expenditure to handle the extra traffic created by hauling from an off-line elevator at Paradise Valley. This is based on the estimate of $51,866 per year cost of step number one above.

Normal maintenance of a surface treated road, the maximum specification likely justified as a future link from Paradise Valley to Edgerton, involves re-oiling every six or seven years. The increase in traffic due to the off-line elevator operation might be projected to decrease the time interval between re-oiling operations. The annual cost of re-oiling considering complete oil and gravel cost as presented in the October 1975 submission by Alberta Transportation would be $8,500 per mile divided by the years of service in the interval.

It would be conservative to estimate that the resurfacing time cycle could go from say six years to four years under the increased traffic. This would increase the average annual expenditure by about $700 per mile which amount to $15,400 for the 22 miles.

The October submission of Alberta Transportation stated that the total annual maintenance cost of a gravel road would be $900 per mile. The R.M. of Enfield submission to the Commission at the Central Butte hearing proposed that if extra traffic should result in a regravelling cycle (250 yards per mile) of every two years, in place of the present three year interval, grid road costs would be increased

$90 to $180 per mile per year.

The above analysis and statement indicate that the allowance of $1,148,000 or yearly $2,400 per mile is excessive for extra expenditure due to road costs associated with grain hauling from an off-line elevator at Paradise Valley. These Alberta Transportation estimates would appear to be three to four times higher than necessary considering an oiled road for the Furness subdivision "off-track elevator" example.

INCREMENTAL ROAD COST ESTIMATES FROM PROVINCIAL GOVERNMENT SUBMISSIONS

Province of Alberta

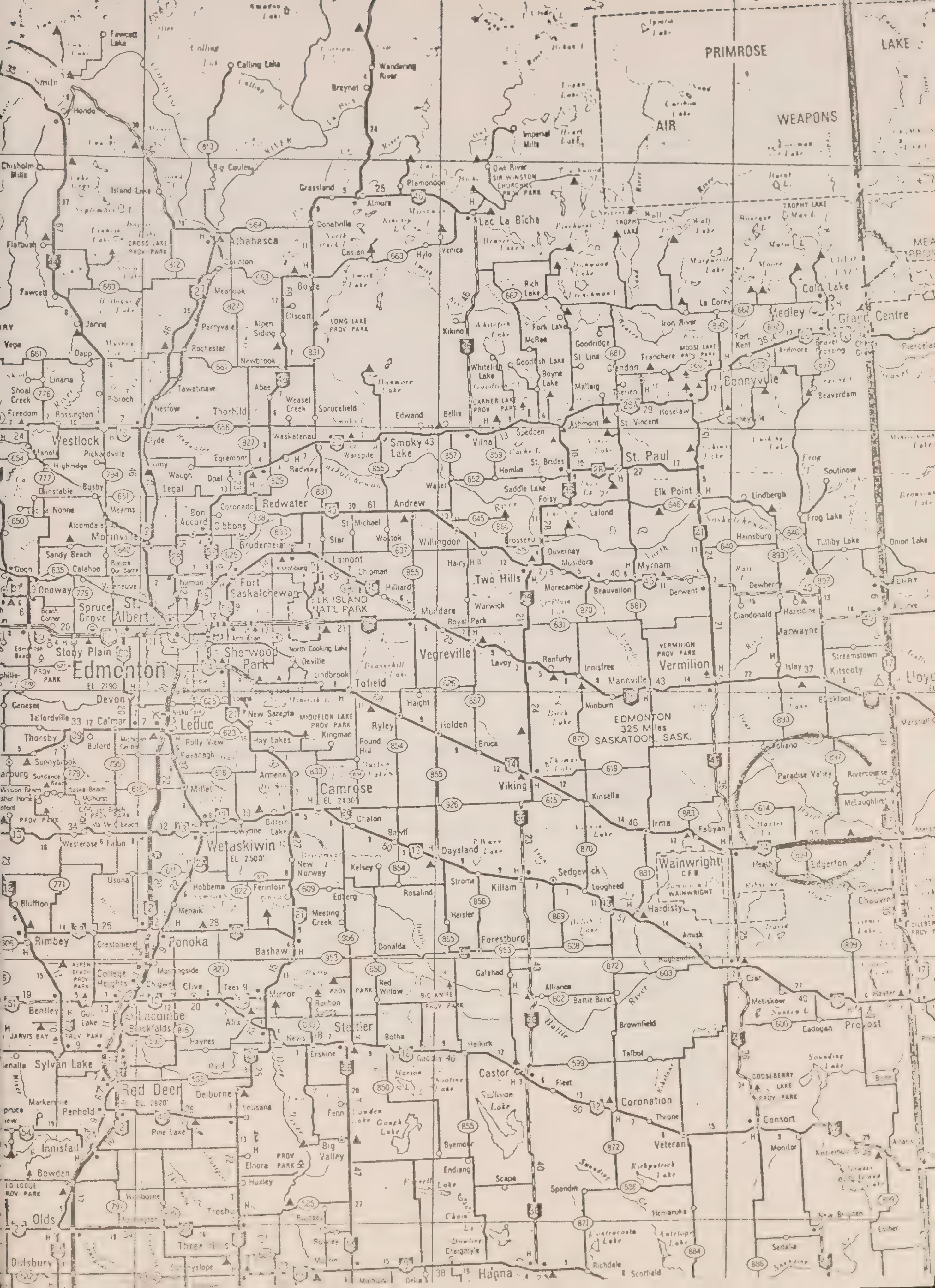
Present worth of costs assuming eight percent inflation and ten percent discount rate

= $37,016,000 to cover a 20 year period
(Note that the effective interest rate is 1.85 percent)

$$\frac{\text{Amount}}{\text{Year}} = \frac{i}{1 - (1 + i)^{-n}} \times \text{P.V.}$$

$$= \frac{.0185}{1 - (1.0185)^{-20}} \times \$37 \times 10^6$$

= $2,230,000 (1975 constant dollar annual cost)



PRIMROSE
LAKE
AIR
WEAPONS
Calling Lake
Wandering River
Breynet
Imperial Mills
Owl River
SIR WINSTON CHURCHILL PROV PARK
Grassland
Plamondon
Atmore
Lac La Biche
Athabasca
CROSS LAKE PROV PARK
Donatville
Casian
Hylo
Venice
Boyle
Colinton
Meanook
Perryvale
Rochester
Alpen Siding
Ellscott
LONG LAKE PROV PARK
Newbrook
Tawatinaw
Abee
Weasel Creek
Sprucefield
Edwand
Bellis
Thorhild
Kikino
Whitefish Lake
Goodfish Lake
Boyne Lake
GARNER LAKE PROV PARK
Rich Lake
Fork Lake
McRae
Goodridge
St Lina
Glendon
Franchere
Iron River
La Corey
MOOSE LAKE PROV PARK
Mallaig
Therien
Ashmont
St Vincent
Hoselaw
Medley
Cold Lake
Grand Centre
Fort Kent
Ardmore
Beaver Crossing
Bonnyville
Beaverdam
Chisholm Mills
Island Lake
Flatbush
Fawcett
Jarvie
Vega
Dapp
Linaria
Shoal Creek
Pibroch
Freedom
Rossington
Nestow
Westlock
Pickardville
Highridge
Busby
Dunstable
Clyde
Egremont
Waugh
Legal
Opal
Radway
Warspite
Smoky Lake
Waskatenau
Vilna
Spedden
Hamlin
St. Brides
St. Paul
Saddle Lake
Foisy
Elk Point
Lindbergh
Frog Lake
Heinsburg
Tulliby Lake
Onion Lake
Mearns
Alcomdale
Morinville
Bon Accord
Gibbons
Coronado
Redwater
Andrew
St Michael
Star
Wostok
Willingdon
Lafond
Brosseau
Duvernay
Musidora
Myrnam
Sandy Beach
Calahoo
Onoway
Bruderheim
Lamont
Chipman
Hilliard
Hairy Hill
Two Hills
Morecambe
Beauvallon
Derwent
Dewberry
Fort Saskatchewan
ELK ISLAND NAT'L PARK
Mundare
Warwick
Royal Park
Spruce Grove
St. Albert
Clandonald
Hazeldine
Marwayne
Stony Plain
Edmonton
EL 2190
Sherwood Park
North Cooking Lake
Deville
Lindbrook
Tofield
Vegreville
Lavoy
Ranfurly
Innisfree
Mannville
VERMILION PROV PARK
Vermilion
Islay
Streamstown
Kitscoty
Lloyd
Genesee
Devon
Telfordville
Calmar
Leduc
New Sarepta
MIQUELON LAKE PROV PARK
Haight
Holden
Ryley
Kingman
Round Hill
Bruce
Minburn
Birch Lake
EDMONTON 325 Miles SASKATOON, SASK.
Thorsby
Buford
Rolly View
Kavanagh
Hay Lakes
Sunnybrook
Armena
Camrose
EL 2430
Viking
Kinsella
Paradise Valley
Rivercourse
McLaughlin
Millet
Ohaton
Bawlf
Daysland
Irma
Fabyan
Westerose
Wetaskiwin
EL 2500
Bittern Lake
New Norway
Kelsey
Strome
Killam
Sedgewick
Lougheed
Wainwright CFB
Hardisty
Heath
Edgerton
Chauvin
Usona
Hobbema
Ferintosh
Rosalind
Edberg
Menaik
Meeting Creek
Heisler
Forestburg
Amisk
Bluffton
Rimbey
Crestomere
Ponoka
Bashaw
Donalda
Hughenden
Czar
College Heights
Morningside
Clive
Tees
Mirror
Red Willow
BIG KNIFE PROV PARK
Galahad
Alliance
Battle Bend
Brownfield
Metiskow
Provost
Cadogan
Bentley
Gull Lake
JARVIS BAY
Lacombe
Blackfalds
Alix
Haynes
Nevis
Stettler
Erskine
Botha
Gadsby
Halkirk
Castor
Talbot
Fleet
Coronation
Sylvan Lake
Red Deer
EL 2820
Delburne
Markerville
Penhold
Lousana
Fenn
Big Valley
Sullivan Lake
Byemoor
Throne
Veteran
GOOSEBERRY LAKE PROV PARK
Consort
Monitor
Innisfail
Pine Lake
Elnora
Bowden
Huxley
Endiang
Scapa
Spondin
Kirkpatrick Lake
Olds
Trochu
Three Hills
Rumsey
Rowley
Craigmyle
Hemaruka
Richdale
Scotfield
Hanna
Didsbury
Sedalia
New Brigden

Examples of Increases In Traffic Based On the Assumption Of Off-Line Operation Of Elevators With Commercial Trucking To On-Line Points				
Subdivision	Point of Origin	Destination	Main Road Affected	Additional ESAL's during Peak Period*
Acadia Valley	Acadia Valley	Oyen	19 miles of #41	24
Alida	Alida	Carnduff	18 miles of #318	19
	Storthoaks	Carievale	15 miles of #8	12
	Tilston	Pierson	14 miles of #256 2 miles of #345	10
Fife Lake	Big Beaver & East Poplar	Coronach	12 miles grid & 7 miles #36	19
Furness	Paradise Valley McLaughlin & Rivercourse	Edgerton Lloydminster	22 miles of #897,894 & 7 miles of grid and 22 miles #17	14 17
Inwood	Broad Valley & Fisher Branch	Arborg	13 miles of #16 & 18 miles #68	19
Lyleton	Lyleton	Pierson	3 miles #251 8 miles #256	12
Meskanaw	Alvena	Prudhomme	17 miles grid	14
	Yellow Creek & Meskanaw	Kinistino	23 miles grid	15
	Ethelton	Beatty	5 miles grid & 6 miles #368	5
Riverhurst Central Butte & Main Centre	Main Centre & Gouldtown	Herbert	15 miles grid	12
	Riverhurst, Lawson Central Butte & Mawer	Eyebrow	34 miles #42	55

* Peak loading is based on 40 percent of total grain movement taking place during a two month period.

Province of Saskatchewan

Present worth of costs assuming eight percent inflation and ten percent discount rate

= $62,000,000 to cover a 15 year period
(Note that the effective interest rate is 1.85 percent)

$$\frac{\text{Amount}}{\text{Year}} = \frac{i}{1 - (1 + i)^{-n}} \quad \times \text{ P.V.}$$

$$= \frac{.0185}{1 - (1.0185)^{-15}} \times \$62 \times 10^{6}$$

= $4,770,000 (1975 constant dollar annual cost)

Province of Manitoba

The cost of upgrading (construction) for roads of all classes would be $41,846,800 to $93,700,000; note that no figure has been presented for total increase in maintenance cost.

Canada Grains Council Brandon Area Study

For the 181.5 miles of road affected, the total cost of maintenance and construction attributable to increased truck traffic equalled an annual charge of $258 thousand based on amortizing gravel roads over a 40 year period and paved roads over an eight year period. Provincial revenue from truck licensing fee and fuel tax of $19 thousand was deducted to equal 3.09 cents per bushel over 7.7 million bushels to cover extra road costs.

ROAD DATA

Province of Alberta

-- Description of Primary Highways

	Mileage
Four or Six Lane Pavement	394
Two Lane Pavement	5,540
Oil Treatment	901
Gravel	670

-- Current Expenditures (1974-75)

Bridge Construction	$ 15,046,000
Primary Highway Construction	91,284,000
Secondary Road System	20,779,000
Grants, etc.	---
TOTAL	$190,275,000

-- Estimated annual additional costs relative to total 1974-75 construction and maintenance

$$\frac{2,230,000}{112,063,000} = 2.0 \text{ percent}$$

Province of Saskatchewan

-- Description of Roads

	Mileage
Four Lane Pavement	296
Two Lane Pavement	3,664
Oil Treatment (low quality pavement) ..	5,669
Gravel Highways	2,847
Gravel Grid*	16,000
Main Farm Access	17,000
Unimproved	60,000 to 70,000

---

* The proposed "Super Grid" system (1½"asphalt mat on surface) will involve upgrading of 5,000 to 8,500 miles of present grid roads at a cost of about $20,000 per mile for a total of nearly 200 million dollars.

-- Current Expenditures (1974-75)

Bridge Construction	$ 1,000,000
Highway Construction	57,585,000
Maintenance of Highways and Bridge ..	23,175,000
Other	---
TOTAL*	$96,760,000

-- Estimated annual additional costs relative to total 1974-75 construction and maintenance:

$$\frac{4,770,000}{80,760,000} = 5.9 \text{ percent.}$$

Province of Manitoba

-- Description of Roads

	Mileage
Provincial Trunk Highways	4,000
Provincial Roads	7,500
Municipal Roads	36,000

-- Current Expenditures (1974-75)

Highway Construction	$ 50,315,000
Maintenance of Roads	14,500,000
Other	--
TOTAL	$ 85,183,000

-- Estimated annual additional costs relative to total 1974-75 construction and maintenance:

The Province of Manitoba submission did not provide sufficient detail with regard to maintenance costs. A very rough approximation can be made by assuming that total annual costs as envisioned by the Manitoba Government may be in the order of 10 percent of the higher total upgrading figure presented. That is, annual costs due to increased grain haul are:

.10 x 93.7 million dollars = 9.37 million dollars

which is $\frac{9,370,000}{64,815,000}$ = 14.5 percent of the total construction and maintenance expenditure for 1974-75.

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* Total yearly expenditures projected by the Department of Highways over the next 20 years will be 120 to 150 million dollars.

Estimated Road Costs Related to Grain Deliveries		
	Ten Year Average Grain Receipts Bushels	
	Category II Lines	All Lines
Alberta	49,000,000	208,000,000
Saskatchewan	157,000,000	438,000,000
Manitoba	45,000,000	117,000,000
	Road Costs -- Cents Per Bushel	
	Category II Lines	All Lines
Alberta $2,230,000 per year	4.6	1.1
Saskatchewan $4,770,000 per year	3.0	1.1
Manitoba Canada Grains Council based on 1973 costs and deliveries $258,000	3.5 (7.7 million bu.)	0.91 (28.3 million bu)

CHAPTER 3

THE ENERGY IMPLICATIONS OF RATIONALIZATION OF LIGHT DENSITY TRAFFIC BRANCH LINES

Clayton, Sparks
& Associates Ltd.

EXECUTIVE SUMMARY

Background to this Report

The work of the Grain Handling and Transportation Commission is directed towards assessing and recommending to Government the developmental requirements of the prairie grain handling and transportation system. In light of the fact that certain of the developmental options being considered by the Commission envisage decreased rail participation in grain assembly, with an attendant increase in trucking; and in light of the expressed feelings and concerns of many that such adjustments would dictate a necessary, possibly substantial, increase in the energy requirement of the system; the Grain Handling and Transportation Commission commissioned a study on the energy requirements and costs of assembling grain by rail and truck in the prairies. This is the report of the study.

Study Objectives

The Grain Handling and Transportation Commission defined the general study objective as follows:

> "to compare energy costs and consumption in the movements of grain by rail and truck from light-density traffic branch-lines."

Within the context of this general objective, the Commission identified certain specific case-type situations to assess, including:

> "(a determination of) energy costs and consumption in rail movement of grain from elevators located on light-density branch-lines;
>
> "(a determination of) energy costs and consumption

in commercial truck movement of grain from elevators located on light-density branch-lines; and,

"(a determination of) energy costs and consumption in commercial and farm truck movements of grain from farms to country elevators."

Study Findings

1. Based on the number of gallons of fuel consumed per bushel-mile of haul, rail is approximately 11.9, 9.4, and 4.9 times more energy efficient than the private farm truck, custom farm truck, and commercial grain truck respectively, when operating in grain assembly.

   From the strict energy input standpoint (i.e. a BTU basis as distinct from the above gallonage basis), these ratios are 10.6, 8.5, and 4.9, respectively.

2. Based on total fuel cost (including taxes) measured in cents per bushel-mile of haul, rail is approximately 13.3, 10.8, and 7.3 times as fuel cost effective as is the private farm truck, custom farm truck, and commercial grain truck, respectively, when operating in grain assembly.

3. Regardless of the unit efficiencies of rail, for many branch-lines in the Brandon area, and the retention of private farm truck haul, would produce a net annual increase in fuel required for grain assembly equivalent to the amount of fuel consumed by only one typical commercial highway truck in a year.

4. Pursuit of a positive policy of encouraging shifts in grain haul from small farm trucks to large commercial grain trucks has considerable potential for conserving, and indeed reducing, the energy required of grain transportation, even under circumstances where branch-lines are abandoned.

   To illustrate, abandonment of 270 miles of branch-lines in the Brandon area, if accompanied with wide-scale employment of commercial grain trucks in place of private farm trucks, produces net annual decreases in the amount of fuel required for grain assembly in the area.

5. The government tax revenue implications of changes in fuel consumption effected by limited rationalization are relatively minor.

   However, provincial governments can stand to gain revenue as a result of shifts from private farm truck haulage to commercial truck haulage of grain. In particular, in Saskatchewan under the current farm fuel rebate program, such shifts can realize net total government gains of 12 cents per one thousand bushel-miles of haul.

6. There is an apparent need to develop more substantial empirical rail data respecting fuel consumption in the branch-line setting in the prairies.

   Given the very limited amount of such data made available during the course of this study, and the substantial difference between

the average rail fuel consumption rate that has been derived and used in this study vs. the consumption rate suggested by one of the railways, the question of a firm rail consumption rate applicable to grain assembly in the prairies remains somewhat unresolved.

INTRODUCTION

Background to the Study

The work of the Grain Handling and Transportation Commission is directed towards assessing and recommending to Government the developmental requirements of the prairie grain handling and transportation system. In light of the fact that certain of the developmental options being considered by the Commission envisage decreased rail participation in grain assembly, with an attendant increase in trucking; and in light of the expressed feelings and concerns of many* that such adjustments would dictate a necessary, possibly substantial, increase in the energy requirement of the system; the Grain Handling and Transportation Commission has commissioned this study on the energy requirements and costs of moving grain by rail and truck in grain assembly.

The Need for the Study

There are two basic reasons for the study. Firstly, the energy efficiencies of the rail and truck modes, and components of the truck mode,** operating in grain assembly in the prairies, have yet to be specifically investigated. The relatively slow speeds and oft times small size of trains operating in grain assembly; and the relatively small size of truck normally employed in grain haul; suggest that

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* See for example the submissions of the Manitoba and Saskatchewan Governments to the Grain Handling and Transportation Commission - pages 19 and 24 respectively.

** The private farm truck, the custom farm truck, and the commercial grain truck.

indiscriminate use of modal system average transportation energy efficiencies, as presented in the literature,* for assessing energy requirements in grain assembly, is somewhat questionable.

Secondly, energy implications of rationalization are obviously a function of attendant routing implications, as well as unit energy consumption rates. In this regard, it is easily demonstrated that railway grain hauls from certain centres are effected in such a circuitous manner that energy savings can be realized by diverting the grain (through increased truck haul) to centres from which rail routing is more direct.

Study Objectives

The Grain Handling and Transportation Commission has defined the general study objective as follows:

> "to compare energy costs and consumption in the movement of grain by rail and truck from light-density traffic branch-lines."**

Within the context of this general objective, the Commission has also identified certain specific case-type situations to be assessed, including:

> "(a determination of) energy costs and consumption in rail movement of grain from elevators located on light-density branch-lines;
>
> "(a determination of) energy costs and consumption in commercial truck movement of grain from elevators located on light-density branch-lines; and,

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* For example, "Energy - Intensiveness of Transportation", by E. Hirst, Transportation Engineering Journal, February, 1973.

** Study Terms of Reference.

"(a determination of) energy costs and consumption in commercial and farm truck movements of grain from farms to country elevators."*

Study Approach and Scope

The study's general scope has been governed by two prime considerations.

Firstly, each specific branch-line case is unique. For each case, any number of circumstances, conditions, and situations may be effected or affected by branch-line abandonment, or may prevail pre and post abandonment, each of which in their own way contribute to the energy requirements of the associated grain transport activity. The implications of abandonment in one case will not be the same as for another case, either in relative magnitude, or sign.

In recognition of this, the study has been directed at the development of a general methodology and related analytical "tools" which can be used in estimating, or rendering "assessible", the energy implications of any practical branch-line abandonment option. Based on this methodology and its related tools, specifically-defined example abandonment scenarios are then analyzed.

Secondly, while detailed analysis of the study is carried out within a framework of existing technology, regulations, and fuel prices the study has also identified and commented on the possible effects of foreseeable developments in these areas, which could conceivably

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* Study Terms of Reference

and substantially alter the relative energy requirements and costs of the rail and truck modes operating in grain assembly in the future.

Accordingly, three* study elements were defined:

> Study Element 1: Develop a generalized methodology for estimating energy requirements/costs for the collection and movement of grain by rail and truck, to permit the assessment of the energy implications of light-density traffic branch-line rationalization.
>
> Study Element 2: Identify specific branch-line cases to be assessed, and analyze the energy requirement/cost implications of abandonment, utilizing the methodology developed in Element 1.
>
> Study Element 3: Identify and generally assess the implications of foreseeable technological developments, changes in vehicle weight and dimension regulations, and changes in the relative prices of fuels, on the relative levels of energy requirements/costs associated with the movement of grain by rail and by truck.

Study Boundaries

Clarification on the scope of the study can be achieved through a brief comment on what the study does not attempt to do, nor claim to be.

Firstly, it is not a theoretical treatise on "work" and "energy". Nonetheless, the basic theoretical concepts and issues involved in

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* At the commencement of the study, we had also contemplated assessing the energy implications which would be associated with effecting institutional changes in the rail system, such as joint-running rights, branch-line tradeoffs, or traffic interchange, for specific cases of circuitous rail routing. The limitations of the rail fuel consumption data made available to this study precluded any substantial effort in this regard, and the report accordingly does not deal with this consideration further. Given the availability of better rail data, analysis in this regard could be usefully pursued.

the determination of energy requirements of transportation generally and their relevance to the determination of modal energy "efficiencies", have been reviewed and are discussed in Attachment A.*

Secondly, it is not a detailed study on the effects of the wide range of factors which affect the fuel requirements of rail and truck. Basically, the study is limited to the development and employment of "representative", or "average", fuel utilization rates by each mode, as functions of relevant and measurable determinants related thereto.

Thirdly, the study does not consider the so-called "full energy circle". For example, the energy implications of more highway construction in place of less rail maintenance (a likely effect of branch-line abandonment), are not considered.

Fourthly, the study does not investigate the energy implications of changes to the system generally, but only to limited sub-systems (i.e. specific lines/areas). In the same vein, the energy implications of trucking grain to export terminals is beyond the scope of the study. Nonetheless, portions of the data base presented in the report could be employed in such analyses.

Lastly, while realizing that the initial farm to elevator traffic allocations are important determinants of energy requirements, this

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* "Some Transportation Energy Considerations", P.B. Hertz, University of Saskatchewan, 1975. Another excellent reference in this regard in "Railroads and the Environment - Estimation of Fuel Consumption in Rail Transportation", Hopkins, U.S. Department of Transportation.

study does not re-develop a method of traffic allocation. In the specific cases examined, the farm to elevator traffic allocation calculations carried out in other studies is accepted, at face value.

THE ANALYTICAL METHODOLOGY FOR ESTIMATING THE ENERGY IMPLICATIONS OF BRANCH-LINE RATIONALIZATION

The purpose of this section is to develop and describe the basic methodology and analytical tools required to estimate the energy implications of branch-line rationalization (Study Element 1).

Problem Conceptualization

Figure III-1 illustrates a stylized general example of a before and after abandonment situation, wherein grain produced at farm (F) is required to be transported to terminal (T).* In the before and after cases respectively, the grain is transported by truck to primary elevators B (on the branch-line to be closed) and A (on a line remaining open). From the elevators, the grain is moved by Rail to T.

The fuel implications of this adjustment can be represented

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* This example illustrates the most general of situations, except for the one wherein the effect of abandonment would be such as to re-direct the grain produced at F to an alternate terminal (T'). Given a closed system (i.e. grain requirements at T and T'do not change as a result of abandonment), such an effect would in turn require a redirection of an equivalent amount of grain from another producing area (F'), in the "before" case destined to T', to T in the "after" case.

by the following general equation:

$$\begin{array}{c}\text{Change in}\\ \text{Fuel}\\ \text{Consumption}\end{array} = \left[\begin{array}{l}\text{Difference in}\\ \text{fuel required}\\ \text{to truck}\\ \text{grain from F}\\ \text{to A vs. from}\\ \text{F to B}\end{array} + \begin{array}{l}\text{Difference in}\\ \text{fuel required}\\ \text{to position}\\ \text{empty trucks}\\ \text{at F for haul}\\ \text{to A vs. to B}\end{array}\right] + \left[\begin{array}{l}\text{Difference in}\\ \text{fuel required}\\ \text{to rail grain}\\ \text{from A to T}\\ \text{vs. from B}\\ \text{to T}\end{array} + \begin{array}{l}\text{Difference in}\\ \text{fuel required}\\ \text{to position}\\ \text{empty rail}\\ \text{cars at A}\\ \text{vs. at B for}\\ \text{haul to T}\end{array}\right]$$

The full effect of a branch-line closure is the summation of change relating to all the grain traffic originally handled on the line in question.

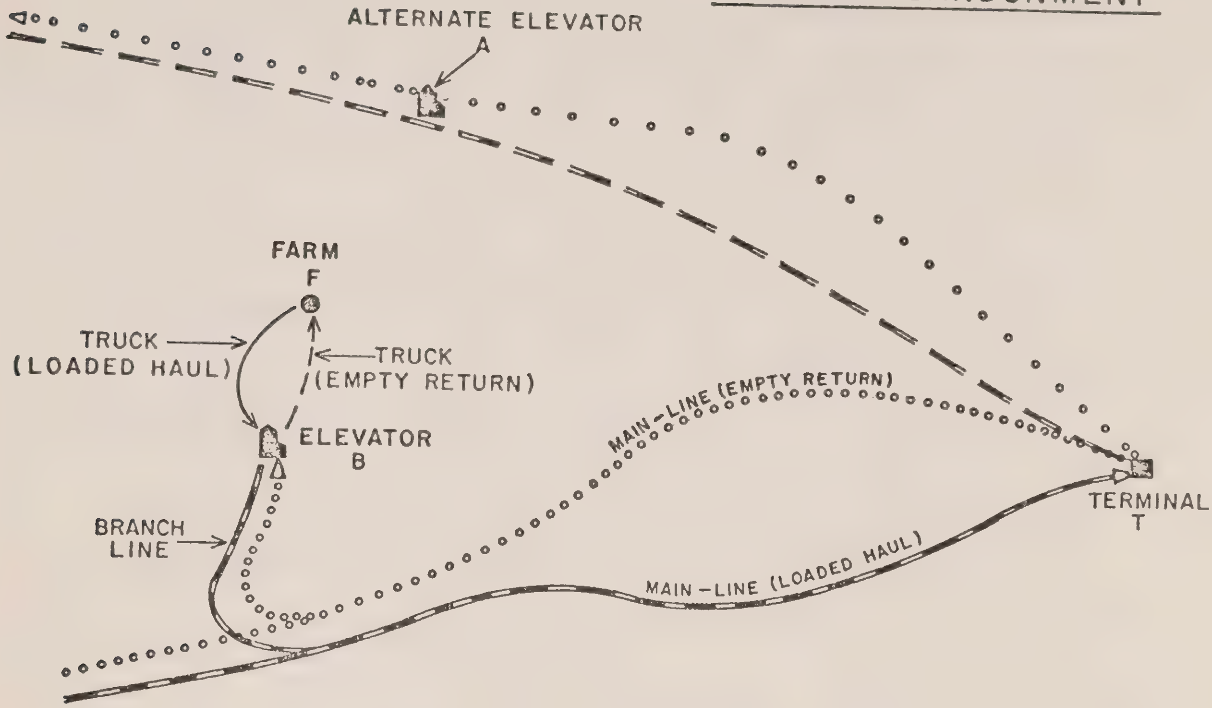
In many cases, the overall effect of abandonment is often less complicated than is the case for the situation illustrated in Figure III-1. For instance, the routing of empty and loaded grain-carrying vehicles is normally common. Further, the loaded and empty rail cars may, in the before and after cases, find themselves at a common rail point somewhere between the primary elevators and the destination terminal. In such a case, where external effects are small or non-existent, the effect of abandonment on fuel requirements need only be assessed between F and the common point, since there is no change beyond the common point.

From the above, it is generally observed that to estimate the energy implications of branch-line rationalization, it is necessary to account for: the effects of rationalization on the energy requirements of both the rail and truck modes, in both the empty and loaded directions of grain haul; between the common points beyond which rationalization has no effect. This sets the framework for the requirements of the analytical methodology, and its "tools".

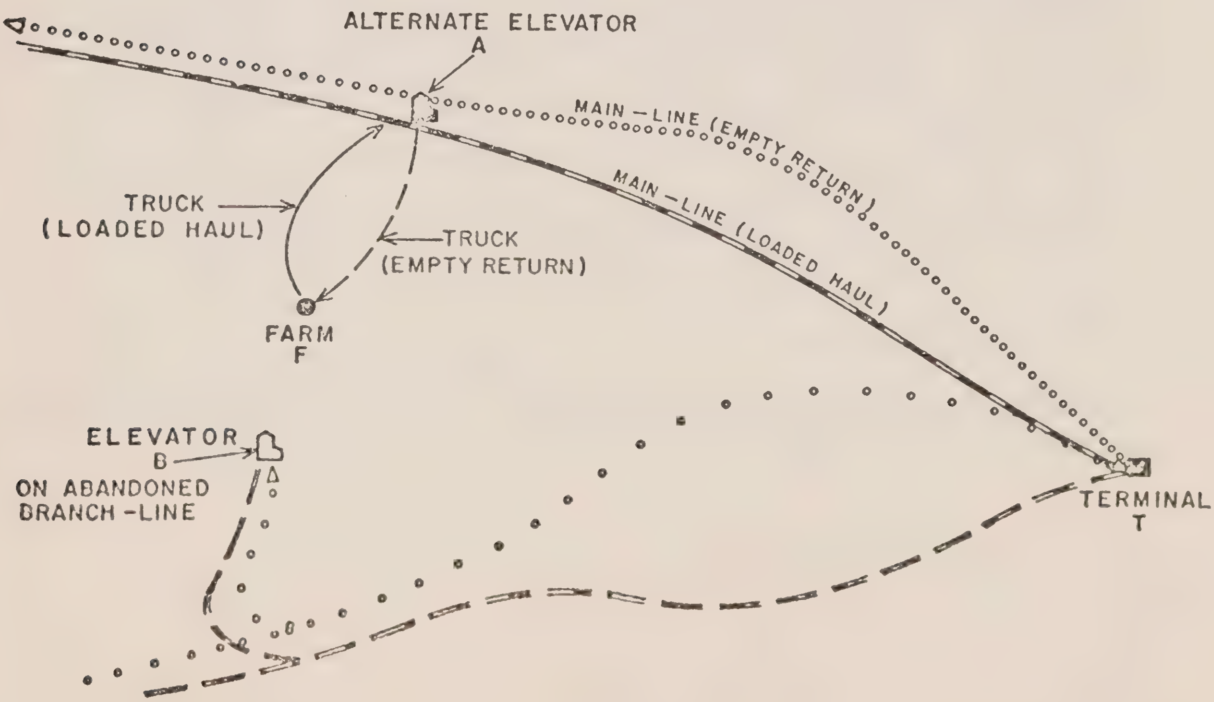
FIGURE III-1

STYLIZED EXAMPLE OF A "*BEFORE*" AND "*AFTER*" BRANCH-LINE ABANDONMENT SITUATION

BEFORE ABANDONMENT



AFTER ABANDONMENT



A Theoretical Review

The need to expend energy in transportation is derived from the requirement in moving products between places to overcome various forms in resistance to motion present on our planet. There are of course several sources of energy available for such purposes, including wind, the horse, coal, the sun, nuclear power, and oil. In recent years, the oil derivatives, gasoline and diesel fuel, have become in effect the sole sources of energy employed in the transportation of grain in Western Canada.

The movement of grain is effected by placing the grain in containers (i.e. truck boxes, rail box-cars) which are attached to "prime movers" (i.e. trucks, train engines), and which transform the potential energy of fuel into mechanical energy capable of performing the work required to overcome the resistances to motion associated with desired movements. It is the extent of these resistances to motion, the potential heat energy of fuels, and the rate at which prime movers transform the heat energy of fuel into useful work output (i.e. thermal efficiency), which together determine the fuel requirements of particular transport movements. In order to develop an understanding of the energy requirements of transport systems, and the relative energy efficiencies of one mode of transport to another, it is useful to briefly consider these three basic concepts: resistance to motion; the stored energy in fuel; and thermal efficiency.

1) Resistance to Motion

There are many forces which act to resist motion of land-borne wheeled-vehicles, including the rolling resistance of wheels, bearing resistance, aerodynamic drag, coriolis loading,* steering resistance, turning resistance, grade resistance, acceleration resistance, chassis friction resistance, and braking resistance. The sum of these resistances, normally expressed in pounds of force per ton (pounds per ton), equals the total resistance which must be overcome to move the vehicle.

Attachement A presents a detailed discussion respecting each of these resistance forces, both from a general theoretical standpoint and a modal-specific standpoint. As is shown, these forces vary significantly between modes, and indeed within each mode, depending on vehicle size, operating speed, load, and many other factors. Given similar or the same fuel types for different modes (in the sense of Btu rating), and relatively similar thermal efficiencies between modes, it is this single factor, resistance, which determines and accounts for, more than anything else, the differences in energy efficiencies between transport modes.

2) The Heat Energy of Fuels

The sources of energy for the truck and rail modes operating in grain assembly are gasoline and diesel fuel. These fuels contain stored heat energy, normally measured in British thermal units (Btu's). A Btu is equivalent to 778 foot pound of energy. In operational terms, given a 100 percent thermal efficient machine, one Btu could be converted to a one pound force acting through 778 feet. Diesel oil and gasoline have average Btu ratings of about 166,500 and 149,200 Btus per gallon respectively. The concentration of heat energy in gasoline is approximately 15 percent less than that in diesel fuel. On a gallonage comparative basis, the inherent differences in the heat energy of fuels, given other things equal, favour those transport modes which utilize higher rated fuels.

3) Thermal Efficiency

Overall thermal efficiency is the ratio of useful work output removed from a system (in this case, a vehicle overcoming

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* Derived from the inertial force caused by the earth's rotation.

travel resistance), divided by the total work-heat equivalent supplied to the system (in this case, via fuel):

$$\text{Thermal Efficiency} = \frac{\text{Ft.Lb. Work Output}}{\text{Btu Fuel Input x 778}} \times 100\%$$

The laws of thermodynamics state that 100 percent thermal efficiencies are impossible, or in other words, that output must always be less than input. (The thermal efficiencies of engines onto themselves depend on a wide range of factors, including size, type, design, load and speed, and can vary from 0, when an engine is idling, to as high as 50 percent for laboratory research Stirling engines).

The typical railroad diesel-electric locomotive operates with an overall thermal efficiency of about 25 percent, while diesel trucks generally obtain a 20 percent thermal efficiency. Gasoline-powered trucks commonly achieve in the range of 16 percent thermal efficiency, with automobiles in the region of ten percent thermal efficiency at the speed at which they achieve their highest mile per gallon performance.*

Again, given other things equal, different modes experience an energy advantage, one to another, simply from the standpoint of their relative abilities to convert the heat energy of fuel into useful work output required to overcome resistance to motion.

As has been stated, it is the combination of the above factors which determine the actual fuel requirements of any particular transport movement. Further, it is these factors which account for inherent differences in fuel requirements between modes and strongly influence the relative transportation energy efficiencies of one mode, or mode element (i.e. private farm truck vs. commercial grain truck) to the next.

Transport Energy Efficiency

Transportation energy efficiency may be defined in various ways, but probably the most commonly employed definition is the division

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* Hertz, ibid.

of net ton-miles of movement by Btu fuel input (or gallons of fuel input, by fuel type):

$$\text{Transportation Energy Efficient } \mu = \frac{\text{Net Ton-miles transported}}{\text{Btu fuel input}}$$

Transportation energy efficiency defined in this way is always much less than one. Accordingly, its inverse is usually quoted in the literature. The greater the value of the inverse, the lower the transportation energy efficiency.

For the purposes of this study, the definition of transportation energy efficiency, and accordingly its inverse, has been modified in a manner which takes specific account of the commodity under study (grain), and the requirement to consider both the empty and loaded direction of haul (as discussed previously - Problem Conceptualization). Specifically, the definition is: the number of gallons of fuel consumed (by fuel type) in both the empty and loaded directions of haul, in effecting a movement of one thousand "typical" bushels (by weight) over a distance of one mile. (The "typical" bushel is discussed in Section 4, and weighs 55 pounds).

A specific example will illustrate the operational meaning of this definition. Assume that grain is hauled in a gasoline-fueled farm truck which operates in the loaded direction at 20 thousand pounds gross vehicle weight (hereafter referred to as g.v.w.) with an 11 thousand pound carrying capacity. The average weight of the grain hauled is 55 pounds per bushel. Therefore, given no volume constraint, the average load per run is 200 bushels (i.e. 11 thousand pounds ÷ 55 pounds per bushel). Assume further that the truck

experiences an average fuel performance rate of 10 miles per gallon, under conditions where for every mile it travels loaded (i.e. at 20 thousand pounds g.v.w.) it travels a return mile empty (i.e. at 9 thousand pounds g.v.w.). Given that the truck is operated in grain haul in a manner where empty miles equal loaded miles, then the inverse transportation energy efficiency for this truck is calculated as follows:

> For 200 bushels to be moved one mile, the truck travels two miles, consuming 0.1 gallons (gasoline) per mile
>
> Therefore:

$$\frac{1}{\mu} = \frac{0.2 \text{ gallons (gasoline)}}{200 \text{ bushel-miles}} = \frac{1.0 \text{ gallons (gasoline)}}{1{,}000 \text{ bushel-miles}}$$

The following two sections respectively develop measures of inverse transportation energy efficiency* for the truck and rail modes operating in grain assembly.

Inverse Transportation Energy Efficiencies for Trucks Operating in Grain Assembly

Three trucking alternatives are available for the farm to elevator element of grain assembly - the private farm truck, the custom farm truck, and the commercial grain truck. Given these alternatives, and the vehicle weight and dimension and "use" regulations in the prairies, grain can be and is transported from farm to elevator in gasoline and diesel-powered trucks ranging in size

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* The term "inverse transportation energy efficiency" is used throughout this report. For the purpose herein, it is simply a measure of the fuel consumption rate of transport modes operating in grain assembly.

from small half-tons to 82 thousand pound g.v.w. combination units. Clearly, because of this wide assortment of trucks used in grain assembly, wide variations in the transportation energy efficiencies of trucked-grain are experienced, when comparing one situation to the next.

The purpose of this section is to develop a schedule of inverse transportation energy efficiency measures over the full range of trucks employed in grain assembly, under the three trucking alternatives. This schedule will serve as a general tool for assessment of the energy implications of specific rationalization options, wherein vehicle characteristics (i.e. size, fuel type) may vary from one specific case to the next.

The basic determinants used in the calculation of this schedule are: gross vehicle weight under load; the ratio of tare weight (and therefore, payload) to loaded g.v.w.; operating speed; the ratio of empty to loaded miles per grain haul; average fuel consumption by vehicular weight at normal operating speeds; the weight of a "typical" bushel; and vehicle type (by fuel consumed).

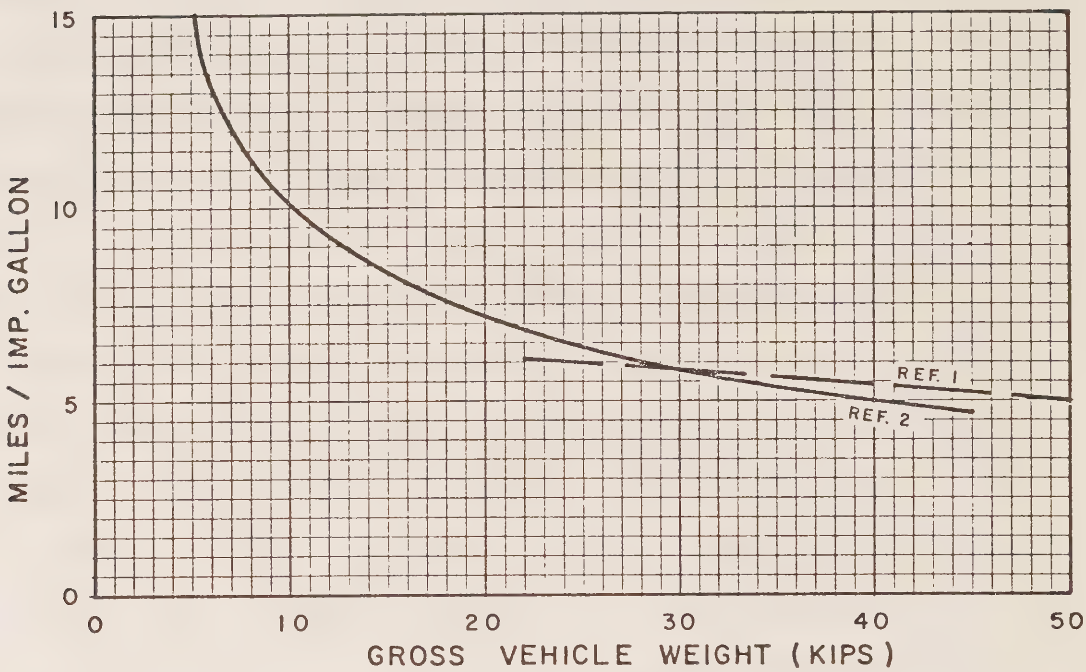
-- Gasoline-Fueled Trucks

Figure III-2 illustrates several empirically developed relationship of gross average miles per gallon, and its inverse, gallons per mile, for different levels of loaded g.v.w., for two and three-axle gas-powered trucks ranging in weight from a g.v.w. of 7,500 pounds to a g.v.w. of 45 thousand pounds.

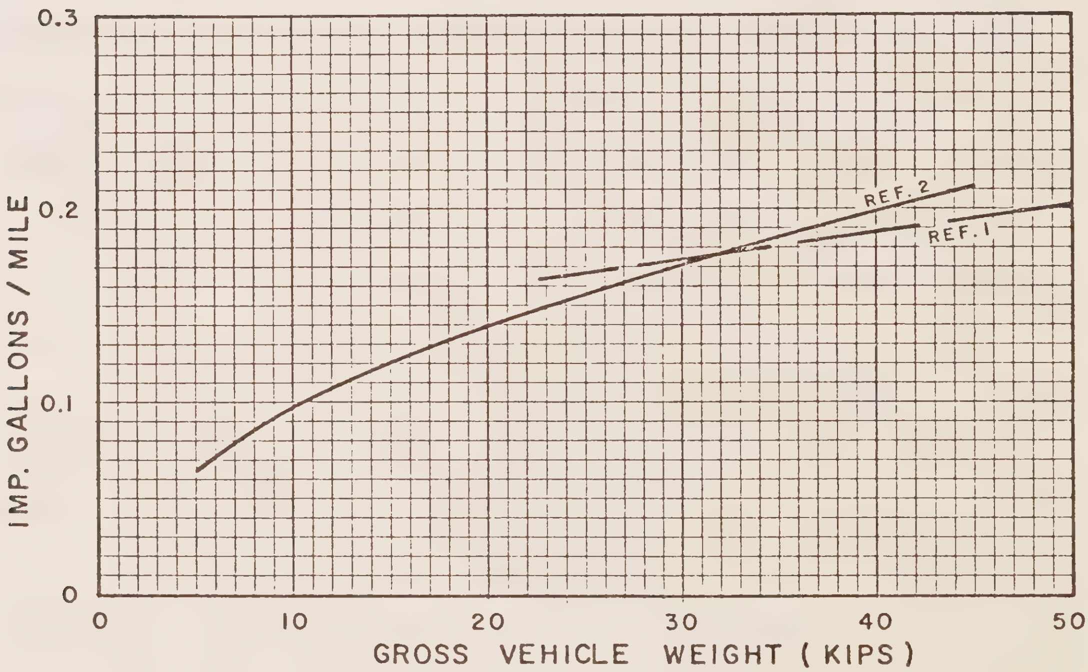
FIGURE III-2

CONSUMPTION RATES FOR GASOLINE - FUELED TRUCKS

MILES PER GALLON vs. GROSS VEHICLE WEIGHT



GALLONS PER MILE vs. GROSS VEHICLE WEIGHT



SOURCE:

REF. 1 H.R.B. BULLETIN 301 — FIG. 47
REF. 2 W.H.I. RESEARCH SUMMARY SERIES NO. 1-74

Trucks in this size range account for the very great majority of both private and custom farm trucks employed in grain assembly in the prairies. Only in very isolated instances are five-axle units employed by farmers in private or custom haul, and such units are nearly solely diesel-fueled.

As developed from various sources, Figure III-3 illustrates the range of the relationship between tare, gross and net weights for the range of gas-powered private farm and custom farm trucks operating in grain assembly. As shown, the range of payloads, at fixed g.v.w. (or fixed tare), is wide, primarily resulting from variations in both vehicle design and operating practice.

Based on our assessment of the adequacy of the information sources which have been utilized to construct Figure III-3, we have estimated the average relationship of loaded gross weight to payload for g.v.w.'s between 10 thousand and 30 thousand pounds for farm truck hauling of grain, as:

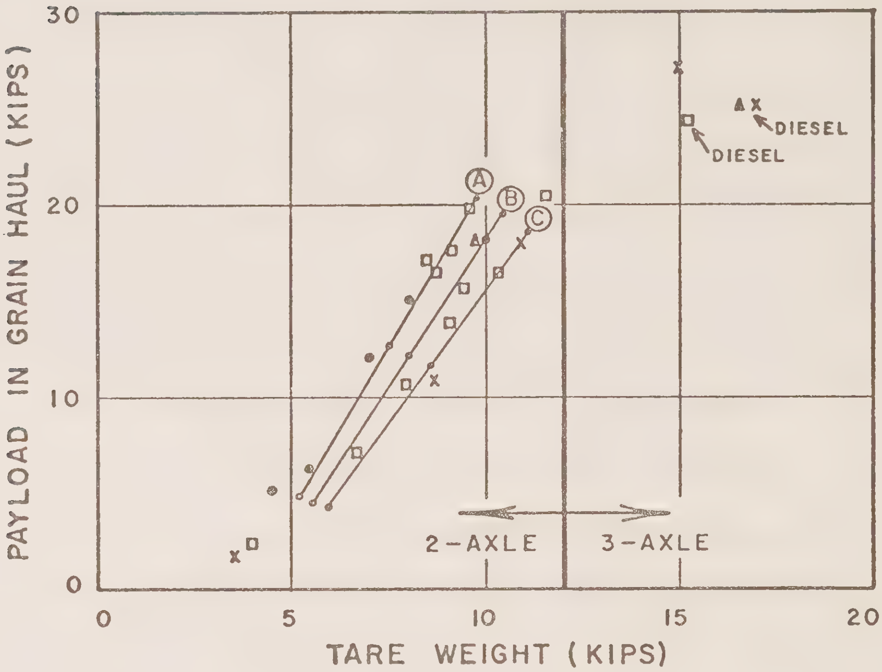
Payload (kips) = 0.755 (g.v.w. - 4.20)
Where: g.v.w. is expressed in kips (i.e. thousands of pounds)

Because of the obvious limitations to this type of estimate, and to examine the sensitivity of calculated energy efficiency measures to error in this estimate, the following possible variations in this average relationship are also considered in the derivations which follows:

Payload (kips) = .775 (g.v.w. - 3.90) High Estimate
Payload (kips) = .735 (g.v.w. - 4.50) Low Estimate
Where: g.v.w. is expressed in kips

Each of these three curves has been superimposed on Figure III-3.

RELATIONSHIP OF PAYLOAD, TARE WEIGHT, AND LOADED GROSS VEHICLE WEIGHT FOR SMALL TRUCKS



SOURCE:

- • DISCUSSIONS WITH COMMERCIAL TRUCKERS
- x DISCUSSIONS WITH TRUCK SALES OUTLETS
- □ ACTUAL OBSERVED GRAIN DELIVERIES
- ▲ H.R.B. BULLETIN 301 — FIGURE 15

NOTE: UNLESS OTHERWISE INDICATED, THE PLOTTED POINTS REFER TO GASOLINE-FUELED TRUCKS

LEGEND:

Ⓐ PAYLOAD = .775 (G.V.W. − 3.90) IN KIPS

Ⓑ PAYLOAD = .755 (G.V.W. − 4.20) IN KIPS

Ⓒ PAYLOAD = .735 (G.V.W. − 4.50) IN KIPS

• FOR G.V.W.'s BETWEEN 10 000 AND 30 000 lbs.

NOTE: THESE CURVES HAVE NO STATISTICAL SIGNIFICANCE, BUT REPRESENT OUR ESTIMATES OF THE LIKELY RANGE OF THE RELATIONSHIP SHOWN.

Utilizing these relationships, and assuming that private and custom farm trucks operating in grain assembly produce one empty return mile for every loaded mile of haul, Figure III-4 has been developed from Figure III-2 to illustrate the fuel requirements of this size range of truck per average running-mile (i.e. half the miles are operated in a loaded state, and half are operated in an empty state) for different levels of g.v.w. in the loaded direction.* For comparative purposes, the frequency distributions of reported fuel mileage performance vs. licensed g.v.w. obtained in a survey respecting farm trucking**, along with the "means" of the illustrated distributions, are also shown in Figure III-4. While the distribution in the survey data is wide, the means compare favourably with the derived average-mile relationship. (It is to be noted that running speeds of farm trucks operating in grain haul average in the order of 30 miles per hour).***

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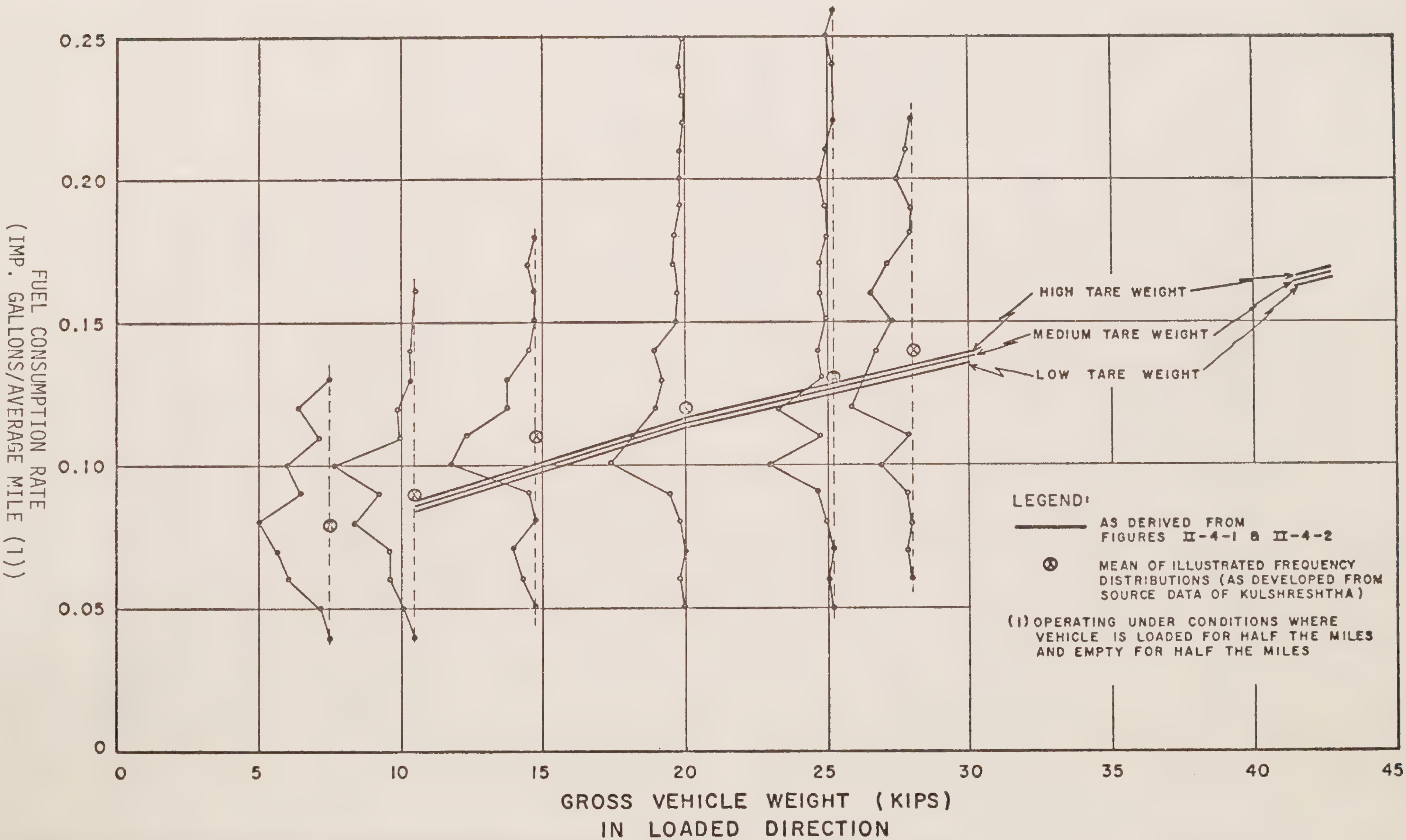
* The fuel consumption schedule of Reference 1 has been employed. This derivation inherently assumes that the consumption schedule applies for the same vehicle in both its empty and loaded state. Clearly, this is questionable from a theoretical standpoint, but any error which might be introduced as a result of the assumption is considered to be well within the bounds of acceptability for the purpose at hand.

** Kulshreshtha, S.N. - "An Economic Analysis of Farm Truck Ownership, Utilization, and Cost of Handling Grain in Saskatchewan"-source data.

*** This is a reasonable average of the data developed by Tyrchniewicz ("The Cost of Transporting Grain by Farm Trucks in the Prairie Provinces" -- Table III-3) and Kulshreshtha (ibid) as derived from Tables III-15 and III-30 for areas B, C, and D.

FIGURE III-4

FUEL CONSUMPTION SCHEDULE GASOLINE-FUELED TRUCKS



Again for comparative purposes, Figure III-5 illustrates calculated consumption schedules for farm trucks, as a function of g.v.w. per tare, speed, and vehicular horsepower. These calculations have been made utilizing the resistance equations discussed in Attachment A, and details are presented in Attachment B. (The plotted curves apply to a situation wherein the truck is empty for half the miles, loaded for half the miles, on gravel half the time, and on pavement half the time). It can be seen that there is a good comparison between the calculated consumption schedule at 35 miles per hour and the data presented in Figure III-4.*

Based on the above, we have concluded that the average mile consumption schedule derived from Reference 1, and illustrated in III-4, is an adequate approximation of the average consumption schedule experienced by private and custom farm trucks operating in grain assembly in the prairies. Recognizing the limitations of this approximation, the derivation of transportation energy efficiencies for private and custom farm trucks will consider the effects of a $\pm$ 5 percent error in the chosen consumption schedule.

Figure III-6 presents schedules of inverse transportation

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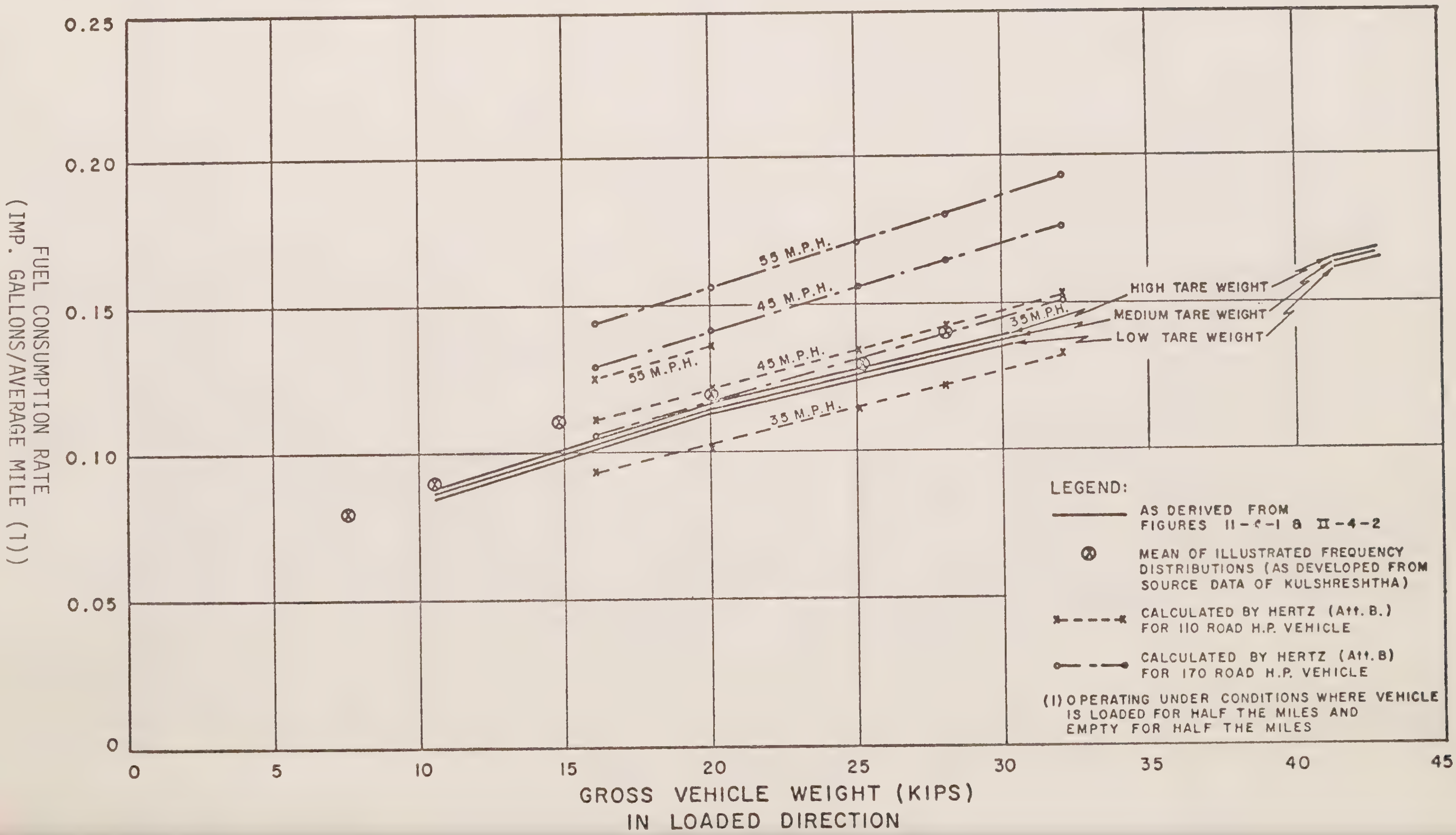
* Note that these calculated consumption schedules do not account for idling or low temperature effects. These effects would of course increase consumption for the average year-round operation. Accounting for these effects would tend to bring a calculated consumption rate schedule at 30 miles per hour in line with the derived schedule.

FIGURE III-5 CALCULATED FUEL CONSUMPTION SCHEDULE
GASOLINE - FUELED TRUCKS



energy efficiencies as developed from the fuel consumption schedules shown in Figure III-4, and the relationships of payload to gross weight described earlier. Payload has been converted to "typical" bushels, using an average weight of 55 pounds per bushel.*'**.

---

* In the prairies, the distribution of bushel deliveries of grain by type is:

	Density lbs./bushel	Kulshreshtha (Ibid) Table 8	Trimac (Exhibit 11)	Brandon Study (p. 17)
Wheat	60	66%	65%	
Barley	48	20%	20%	
Oats	34	2%	7%	
Rye	56		3%	
Rape	50		3%	
Flax	50	11%	3%	
Other	(50)	1%		
Weighted Average Bushel Density		55.9#/bushel	55.2#/bushel	53#/bushel

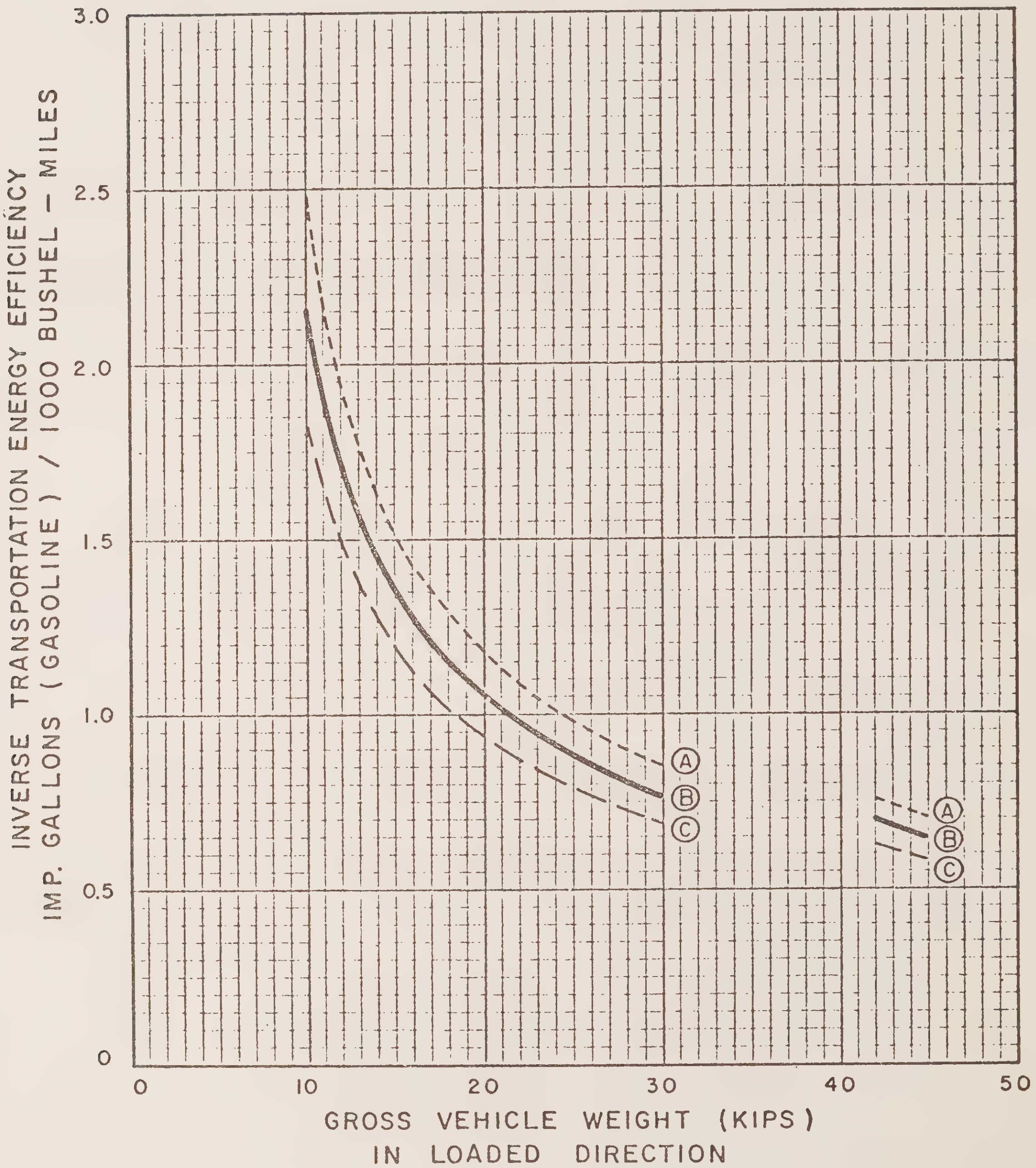
Trimac -- "Evaluation of Commercial Carriage of Grain for the Grains Group".
Brandon Study -- Canada Grains Council.

** An example calculation of the inverse transportation energy efficiency for a loaded g.v.w. of 20,000 lbs. follows:

From Figure III-4 and a ±5% Sensivity Check Fuel Consumed/Return-mile Trip		From Figure III-3 Payload/Return Trip	Inverse Transportation Energy Efficiency Gallons/1000 bushel-miles
High	0.246 gallons	Low 11,390 lbs. (207.1 bushels)	1.19
Medium	0.230 gallons	Medium 11,930 lbs. (216.9 bushels)	1.06
Low	0.214 gallons	High 12,475 lbs. (226.8 bushels)	0.94

FIGURE III-6

SCHEDULE OF INVERSE TRANSPORTATION ENERGY EFFICIENCY FOR PRIVATE AND CUSTOM FARM TRUCKS GASOLINE — FUELED



LEGEND:

Ⓐ — COMBINATION OF "*HIGH*" CONSUMPTION AND "*LOW*" PAYLOAD

Ⓑ — COMBINATION OF "*MEDIUM*" CONSUMPTION AND "*MEDIUM*" PAYLOAD

Ⓒ — COMBINATION OF "*LOW*" CONSUMPTION AND "*HIGH*" PAYLOAD

It can be seen that energy efficiency increases substantially as truck size increases. For the same ten thousand "typical" bushels hauled ten miles, a 12 thousand pounds g.v.w. (loaded) truck would require 170 gallons of gasoline, while a 28 thousand pounds g.v.w. (loaded) truck would require 81 gallons of gasoline.

-- Diesel-Fueled Trucks

For the purposes of this study, the commercial grain truck is considered to be a five-axle hopper-bottom semi, which operates effectively at the maximum g.v.w. and axle weights permitted within the weight and dimension regulations of each province. These regulations vary between provinces, and as well vary within provinces from one road to the next. Accordingly, the weight constraints on a commercial grain truck operation are dependent on the road (and the province) on and in which the truck operates.

Over the allowable range of g.v.w.'s at which five-axle units may operate in the prairies (i.e. 74 thousand pounds to 82 thousand pounds), the tare weight of a unit will not change. In other words, exactly the same vehicle can and does operate at both these limits. As is the case with smaller trucks, the tare weights of commercial grain trucks vary, from an apparent absolute high of 32 thousand pounds to an apparent absolute low of 24 thousand pounds.* The normal tare weight for these units,

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* 32 thousand pounds - discussion with carriers
24 thousand pounds - Trimac - "Evaluation of Commercial Carriage of Grain for the Grains Group".

however, based on discussions with carriers, discussions with weigh scale operators, and an assessment of average loads (by weight) experienced in the Canadian Wheat Board/Saskatchewan Trucking Association haul to inland terminals in 1975, is 26,500 pounds.

A number of references respecting fuel consumption rates for diesel-powered trucks of the size used in grain haul have been examined. (Figure III-7 illustrates these consumption rates). In comparison to the results of discussion with commercial grain truckers, it would appear that this material suggests better fuel performance than is experienced in practise in the prairies. Accordingly, we have chosen to hold with the results of these discussions as being more representative of the situation in the prairies. On a year-round, half empty, half loaded basis of operation, including idling, therefore, average fuel performance for 74 thousand pounds and 82 thousand pounds loaded operations are 5.15 and 5.10 miles per gallon respectively.* At the outside, these average consumption rates can reasonably be expected to be within ± 0.20 miles per gallon of the actual rate.

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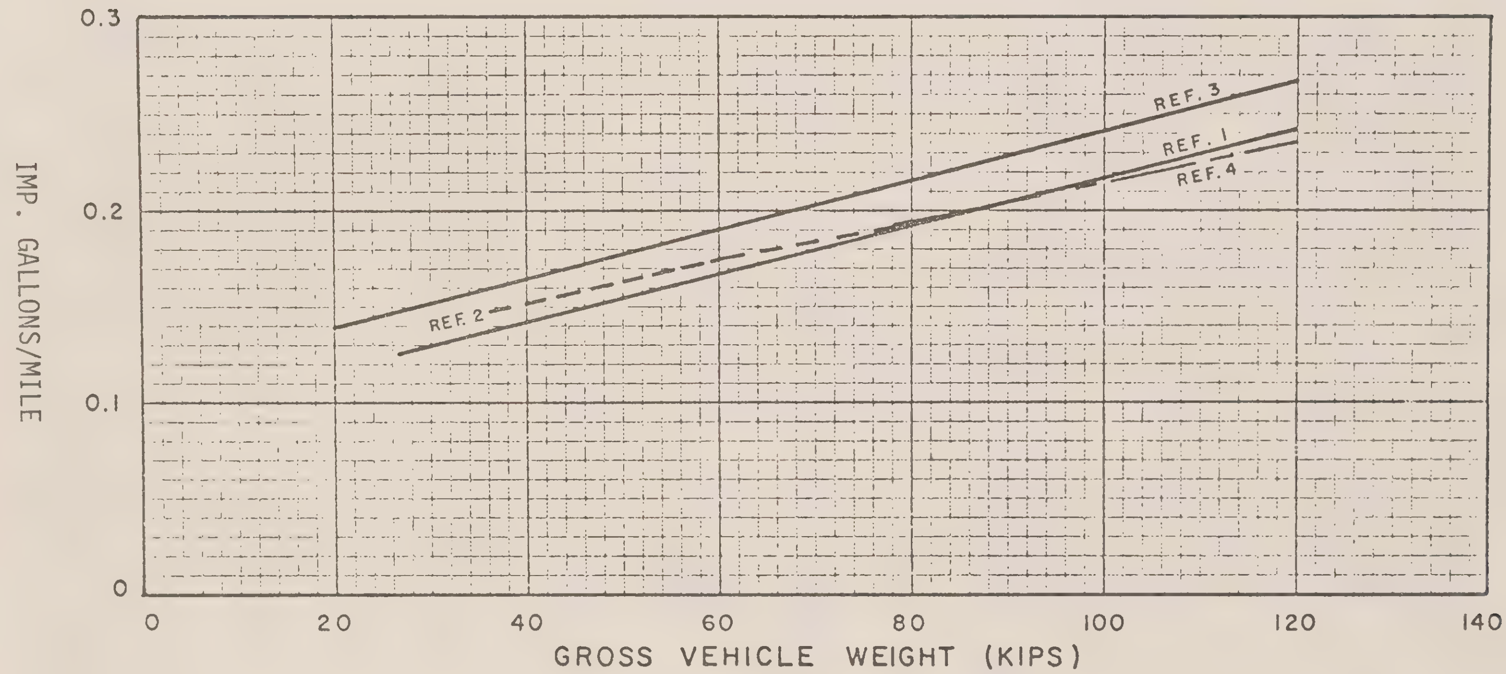
* For costing purposes, the Saskatchewan Trucking Association normally employs a 5.00 m.p.g. fuel performance rate for commercial grain trucking. Preliminary results of the R.T.A.C. fuel tax study have determined the following average consumption rates in the prairies: Manitoba, 4.99 m.p.g.; Saskatchewan, 4.90 m.p.g.; Alberta, 5.60 m.p.g. A Trimac study entitled "Operating Costs of Trucks in Canada" (1973) has utilized average fuel performance rates of 5.5 m.p.g. for Alberta and Saskatchewan.

FIGURE III-7 CONSUMPTION RATES FOR DIESEL - FUELED TRUCKS



SOURCE:

REF. 1 H.R.B. BULLETIN 301 - FIGURE 47
REF. 2 W.H.I. RESEARCH SUMMARY SERIES NO. 1-74
REF. 3 W.H.I. RESEARCH COMMITEE REPORT NO. 2 - FIGURE 58 (AT. 46 M.P.H.)
REF. 4 W.H.I. RESEARCH SUMMARY SERIES NO. 1-74 - FIGURE 1 (AVERAGE)

Based on the above, Table III-1,develops the range of inverse transportation energy efficiencies for commercial trucks, at loaded g.v.w.'s of 74 thousand pounds and 82 thousand pounds.* Again, on a gallonage equivalency basis alone, there are substantial energy savings realized in hauling grain by commercial truck in comparison to a farm truck. For the same ten thousand "typical" bushels hauled ten miles, a 20 thousand pound g.v.w. (loaded) truck would consume 106 gallons of gasoline, while a 74 thousand pounds g.v.w. (loaded) commercial truck would consume 45 gallons of diesel fuel.

TABLE III-1

Calculations of Inverse Transportation Energy Efficiency for Commercial Trucks

G.V.W. loaded direction (lbs.)	Diesel Fuel consumed per return-mile trip (gallons)			Payload per trip lbs./bushel	Inverse Transportation Energy Efficiency Imp. gallons (diesel)/ 1,000 bushel-miles		
	High	Medium	Low		High	Medium	Low
74,000	.404	.388	.374	47,500/863.6	0.47	0.45	0.43
75,000	.404	.388	.374	48,500/881.8	0.46	0.44	0.42
82,000	.408	.392	.378	55,500/1009.1	0.40	0.39	0.37

* For this purpose, we have assumed that commercial grain trucking incurs one empty mile of movement for every loaded mile of haul. Some commercial grain truckers, indeed, report loaded to empty mile ratios which are greater than one.

Inverse Transportation Energy Efficiencies for Rail Operating In Grain Assembly

Transportation energy efficiencies for the rail mode operating in grain assembly can and do vary widely, from one specific line and run to the next. Train consist, speed, ambient temperature, thermal efficiency, grades, curvature, switching, idling, dead-heading, rolling stock design, stops and starts, wind, and other factors, contribute to the fuel requirements of a branch-line run, and variations in these factors create substnatial variations in calculated transportation energy efficiencies between lines, and on the same line between runs. Nonetheless, because of the relatively low absolute level of inverse transportation energy efficiency for rail vs. truck (and in particular, for rail vs. the small farm truck), the significance of these variations, as will be illustrated, is relatively unimportant from the standpoint of modal comparisons of energy efficiency in grain haul.

From the outset, it had been agreed that this study would concern itself only with representative or typical fuel consumption rates, to be provided by the railways, for use in the calculation of rail transportation energy efficiency. In this regard, major sources of available, measured fuel consumption data were not provided.* However, a limited number of specific fuel consumption measurements were

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* Available data not provided included Canadian National Railway's fuel consumption tables developed for costing purposes, and the results of a large number of fuel consumption tests recently conducted by CP Rail.

undertaken by the railways for this study, and the results of some of these were provided.*

Because of the shortage of empirical consumption data, it has been necessary to test the reasonableness of the limited amount provided from the theoretical standpoint, wherein fuel requirements over a range of branch-line situations and operations have been estimated using the resistance equations discussed in Attachment A. These fuel requirements were then converted into measures of transport energy efficiency, and compared with their equivalents derived from the empirical data provided.

Attachment C details the calculation of fuel consumption and inverse transportation efficiencies for a reasonably typical range of branch-line situations and operations. The sensitivity of fuel consumption to certain of the influencing factors is illustrated in these calculations, demonstrating the kind of variation which can occur from one specific fuel measurement to the next.

The basic assumptions used in the calculations are:

1) branch-line originating grain is transported in standard 60 ton box-cars with tare weights of 22 ton "normal" loaded weights of 79 ton, and payloads of 57 ton.**

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* Attachment D presents the results of the specific tests carried our during the course of the study, and reported to us. This data is illustrated in Figure III-8.

** These weights were derived from an assessment of the consist information provided by the railways for a number of branch-line and main-line runs, and general equipments lists. Herein, we have not considered the hopper cars because of their relatively limited employment on light density traffic branch-lines.

2) for each loaded mile travelled by a box-car, the car travels one mile in an empty state.

3) for each mile travelled by a locomotive pulling loaded cars, it travels one mile pulling empty cars.

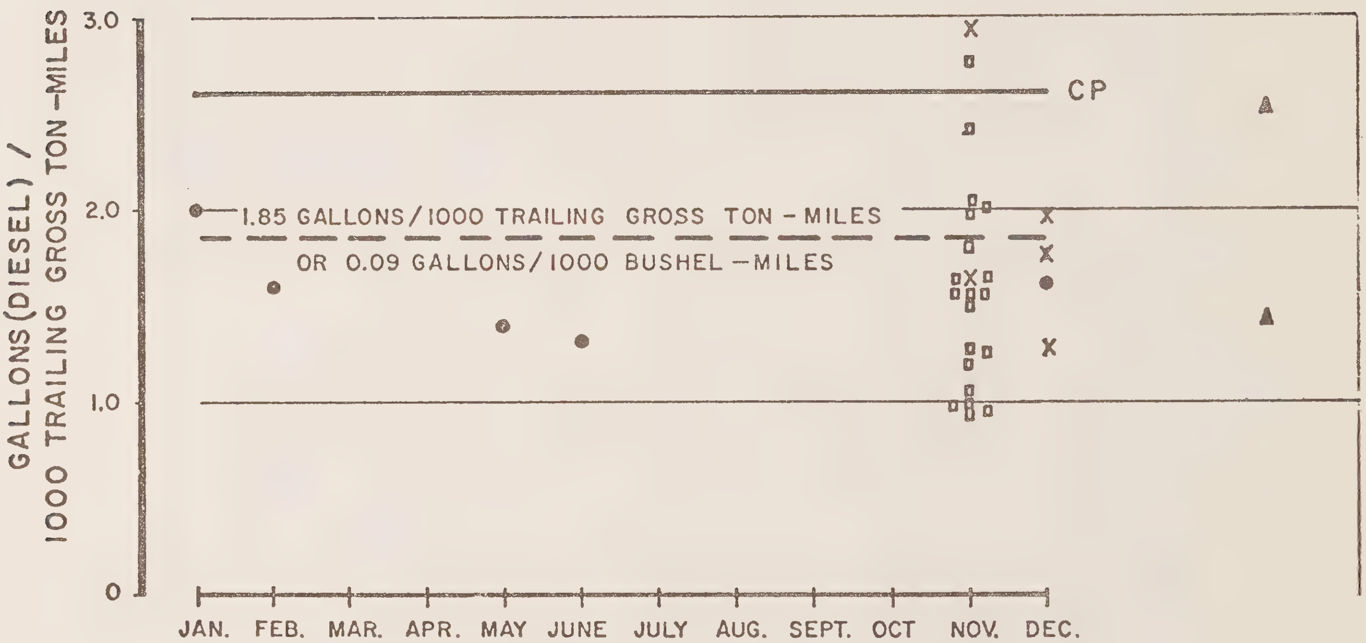
4) the payload of 57 tons is equivalent to 2,070 "typical" bushels (i.e. 55 lbs/bushel).

These calculations suggest that a normal range of inverse transportation energy efficiencies for branch-line operation is from 0.07 to 0.12 gallons of diesel per one thousand bushel miles. Clearly, as can be seen from the calculations, it is totally in order to expect inverse efficiency levels beyond this range on specific runs and lines (i.e. with lower temperatures, greater grade effects, dead-heading operation, higher side winds, and so on). Nonetheless, we believe that the normal branch-line operation for most lines when considered year-round would fall within the calculated range.

For comparative purposes, Figure III-8 illustrates a number of measured consumption rates provided by the railways, including system averages, and a limited number of spot tests. These rates have been developed on the basis of trailing gross ton-miles (i.e. exclusive of the weight of engines). For most of the points plotted, fuel consumed in associated idling and switching has been included in the rate calculation. Based on the Canadian National data, an average experienced consumption rate in the prairie region is about 1.70 gallons per one thousand trailing gross ton-miles, ranging from 1.30

FIGURE III-8

FUEL CONSUMPTION RATES EXPERIENCED BY RAIL IN PRAIRIE OPERATION



LEGEND:

- ● CN PRAIRIE REGION SYSTEM AVERAGES (UN-OFFICIAL)
- X SPOT TESTS (TWO-WAY HAUL) - CN
- ◻ SPOT TESTS (ONE-WAY HAUL) - CN
- ▲ CALCULATED VALUS FOR SPECIFIC SCENARIOS (SEE TEXT AND ATTACHMENT C)
- CP CONSUMPTION RATE APPLIED IN CP's "ON-LINE" SUBSIDY CALCULATIONS FOR C.T.C. (1974) (UN-CONFIRMED)

to 2.10 gallons through the year.* This range and average is considered applicable to cases wherein trains operate on the lines more or less year round, in such a manner as to run basically a train-load (say 20 to 50) of empty 60 ton box-cars "out" a line, returning with approximately the same number of cars loaded. The weight of locomotives would be excluded from the gross ton-mile determination, and consumption would include fuel for idling and switching, both along the run and at both ends of it.

Using the typical bushel load per car of 2,070 bushels, tare car weights of 22 ton, and loaded car weights of 79 tons, for every 101 tons of gross ton-mile haul (i.e. 22 tons empty for one mile, and 79 tons loaded for one mile), 2,070 bushels are moved one mile. Converting the consumption rates discussed above, the average inverse transportation energy efficiency for rail operating in grain assembly is 0.083 gallons of diesel per one thousand bushel miles, normally falling in a range from 0.063 to 0.103 gallons per one thousand bushel miles.

As a further comparison, from Hopkins**,an average consumption

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* In comparison, the study of "Artic Oil and Gas by Rail", 1974, presents data indicating consumption rates of 0.97 to 1.20 gallons per one thousand trailing gross ton-miles, for relatively high speed unit trains hauling oil and LNG.

** Hopkins, "Railroads and the Environment - Estimation of Fuel Consumption in Rail Transportation", 1975. From Figure return trip consumption for a 20 car train, averaging payloads of 57 ton per car (or 2,070 typical bushels per car) and average speeds of 15 miles per hour, is 0.02 pounds diesel per net ton-mile. Diesel fuel weights 8.5 pounds per imperial gallon. Therefore, the converted consumption rate is:

$$\frac{.02 \times 1 \times 20 \times 57}{20 \times 8.5 \times 2.07} \ \frac{\text{gallons}}{\text{1,000 bushels-mi.}} = 0.06 \text{ gallons per 1,000 bushel-miles.}$$

rate of 0.06 gallons per one thousand bushel-miles (assuming no grade effect, and no associated idling and switching) for branch-line operation is derived. Allowing for a grade, idling, and switching effect of 30 percent, this would increase to 0.08 gallons per one thousand bushel-miles.

Based on these various figures, we have concluded that an inverse transportation energy efficiency rate of 0.09 gallons per one thousand bushel-miles can be considered an appropriate rail rate to utilize in modal comparisons, and the analysis of specific case situations.

A Modal Comparison of Inverse Transportation Energy Efficiencies for Private and Custom Farm Trucks, Commercial Trucks, and Rail, Operating in Grain Assembly in the Branch-Line Setting

Utilizing the transportation energy efficiency schedules and rates developed in previous sections, this section develops an overall comparison of modal energy efficiencies of grain collection in the prairies.

Towards this end, it is firstly necessary to establish the point on the small truck schedule (Figure III-6) which approximates the average inverse energy efficiency rate for private farm truck haul. Because of the shape of the schedule, the consumption rate at the average g.v.w. operating level will not necessarily account for the effect on average consumption of the distribution in vehicle size and the distribution of grain haul activity by vehicle size.

To illustrate, from the standpoint of distribution of vehicle size, if one thousand bushels are moved one mile by each of a ten

thousand pounds and 30 thousand pounds gross vehicle weight loaded truck, the average inverse energy efficiency rate is greater than if the two thousand bushels were moved one mile by a 20 thousand pound loaded truck. Conteracting this size distribution effect, however, is the generally observed fact that as activity level (i.e. bushel-miles) of farm trucking increases, so does vehicle size. Kulshreshtha* estimated that average grain box size increased by 2.08 bushels per extra mile of grain haul (where volume remains constant), and by 0.5 bushels per 100 extra bushels of haul (where distance remains constant).** Tyrchniewicz*** and the Area 11 Study**** also conclusively show that as bushel-miles of haul increases, so does truck size.

Accordingly, for purposes of establishing a method of estimating average inverse energy efficiency for the private farm trucking component of grain haul in the prairies, an analysis was undertaken to establish the weighted average loaded g.v.w. figure to employ in the determination of average inverse energy efficiency. In this regard, utilizing Table 13 from Kushreshthna*****, Table III-2 has been constructed to estimate the bushel-mile activity for each cell in the

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* ibid. p. 49

** ibid. p. 49

*** ibid. p. 24

**** Canada Grains Council Study of Rationalization in the Rosetown Area - Chapter on Farm Truck Costs.

***** ibid.

matrix of "bushels delivered" vs. "average one-way hual distance".* Table III-3 shows the calculated values of the average g.v.w. relevant to the haul requirements of each cell. Table III-4 details the calculations of the average inverse energy efficiency, and the corresponding weighted g.v.w. load, over the complete activity range.

The derived average inverse energy efficiency of this analysis, of 1.065 gallons per one thousand bushel-miles, is, from Figure III-6, associated with a loaded g.v.w. of 19.900 pounds. Comparing this with the observed average (licensed) g.v.w. determined by Kulshreshtna** of 19,940 pounds, the two are considered, for all intents and purposes, equal. Further, using data developed by both Tyrchniewicz and Kulshreshtha,*** this weighted g.v.w. of 19,940 pounds is approximately

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* For this purpose "average bushels" is simply the mean of the bushel groupings shown in Table 13, and "average distance" has been approximated by the equations: avg. distance = low of grouping + 2/3 grouping size. (Note that this approximation is relatively crude, holding substantially true only when "low end of grouping" is 0 or greater than 3/4 of "high end of grouping" for a circular collection area served by radia roads. Nonetheless, for the purpose at hand, it is felt that any error introduced as a result of employing this assumption is within the scope of accuracy of the analysis generally).

** ibid. - Table 6

*** ibid. - Tyrchniewicz (Table 1)

Avg. Box Capacity (Western Canada)= 217.5 bushels

$$\text{Payload} = \frac{217.5 \times 55}{1{,}000} = 11.96 \text{ kips}$$

$$\text{g.v.w.} = \frac{11.96}{.755} + 4.20 = 20{,}040 \text{ pounds}$$

\- Kulshreshtha (Table 6)

Avg. Box Capacity (All Areas) = 214 bushels

$$\text{g.v.s.} = \frac{214 \times 55}{.755 \times 1{,}000} + 4.20 = 19{,}790 \text{ pounds.}$$

TABLE III-2

Estimation of Bushel-Mile Activity
By
Delivered Quantity vs. Haul Distance
(1,000 bushel-miles[3]/% Total Activity[4])

Avg. Bushels Delivered(1) \ Avg. Haul Distances (2)	4	9.3	17.6	27.6	37.6	42
2,000	272/0.8	484/1.4	669/2.0	883/2.6	827/2.4	1,344/3.9
6,000	1,200/3.5	1,450/4.3	950/2.8	496/1.5	676/2.0	1,008/2.9
10,000	1,040/3.0	3,255/9.5	1,408/4.1	552/1.6	nil	x
14,000	1,680/4.9	2,473/7.2	1,478/4.3	386/1.1	nil	x
18,000	1,152/3.4	2,511/7.3	950/2.8	nil	x	x
21,000	1,512/4.4	4,101/12.0	1,478/4.3	x	x	x

where: x -- involved custom trucking only

(1) average of grouping. For example, for grouping 8,001 - 12,000 bushels, average equals ten thousand bushels.

(2) estimated on the basis of: lower range of grouping + 2/3 of grouping size. For example, for group range 11 - 20.9 miles, average haul distance is assumed equal to 11.0 + 2/3(9.9) = 17.6 miles.

(3) bushel-miles calculated as follows, for example cell (2,000 bushels x 4 miles):

4 miles/truck x 2,000 bushels x 34 trucks = 272,000 bushel-miles

where: "34 trucks" is derived from Julshreshtha (Table 13) for this cell.

(4) Percent of total activity for each cell is calculated by:

--activity in cell ÷ total activity x 100%.

TABLE III-3

Estimation of Truck Size

(in g.v.w.) for each "mileage per delivery" cell

in Table III-2

Average utilized box capacity[(1)] (bushels) per loaded g.v.w.[(2)] (kips)

Avg. Bushels Delivered \ Avg. Haul Distance	4	9.3	17.6	27.6	37.6	42
2,000	137/14.0	127/13.2	157/15.5	157/15.5	150/15.0	181/17.1
6,000	154/15.1	163/16.0	240/21.9	252/22.8	306/26.7	363/31.0
10,000	195/18.5	214/20.0	210/19.5	217/24.1	--	--
14,000	223/20.5	215/20.0	213/20.0	294/26.0	--	--
18,000	186/17.5	241/22.0	245/22.2	--	--	--
21,000	256/23.0	252/22.5	294/26.0	--	--	--

(1) Average utilized box capacity has been calculated using the box capacity figures quoted in Kulshreshtha - Table 13, and the average box capacity load factor for the prairies of 91.8 percent determined by Tyrchniewicz, (ibid. p. 11).

ex. calculation for cell (ten thousand bushels by 17.6 miles)

avg. box capacity = 229 bushels
avg. bushel load = 229 x .918 = 210 bushels.

(2) Loaded g.v.w. is derived from avg. bushel load, as follows:

payload = average bushel load x typical bushel weight

$$\text{g.v.w. (loaded)} = \frac{\text{payload}}{.755} + 4.2 \text{ (in kips)}$$

- From Figure III-3

∴ For cell (14,000 bushels x 9.3 miles)

$$\text{g.v.w. (loaded)} = \frac{234 \times .918 \times 55}{.755 \times 1,000} + 4.2 = 20.0 \text{ kips.}$$

TABLE III-4

Estimation of Weighted Average Inverse Transportation Energy Efficiency
for Grain Haul by Farm Truck accounting for
Effects of Bushel-Mile Activity Level on Truck Size
(from Tables III-2 and III-3

(Percentage of total activity)(inverse energy efficiency for attendant g.v.w.)
"cell" contribution per one thousand bushel-miles

Avg. Bushels Delivered \ Avg. Haul Distances						
2,000	(0.8)(1.46) .01168	(1.4)(1.55) .02170	(2.0)(1.30) .02600	(2.6)(1.30) .03380	(2.4)(1.35) .03240	(3.9)(1.20) .04680
6,000	(3.5)(1.33) .04655	(4.3)(1.28) .05504	(2.8)(0.99) .02772	(1.5)(0.96) .01440	(2.0)(0.85) .01700	(2.9)(0.76) .02204
10,000	(3.0)(1.13) .03390	(9.5)(1.06) .10070	(4.1)(1.08) .04428	(1.6)(0.90) .01440	--	--
14,000	(4.9)(1.04) .05096	(7.2)(1.06) .07632	(4.3)(1.06) .04558	(1.1)(0.86) .00946	--	--
18,000	(3.4)(1.17) .03978	(7.3)(0.98) .07154	(2.8)(0.98) .02744	--	--	--
21,000	(4.4)(0.95) .04180	(12.0)(0.97) .11640	(4.3)(0.86) .03698	--	--	--

Example Calculation: For cell (18,000 bushels x 9.3 miles)
activity level = 7.3% of total (from Table III-2)
average loaded g.v.w. = 22.0 kips (from Table III-3)
corresponding 1/u = 0.98 gallons per 1,000 bushel-miles (from Figure
cell contribution = 0.073 x 0.98 = 0.07154 gallons

For 1,000 bushel-miles, weighted average inverse energy efficiency is:
contribution of each cell = 1.06467 gallons per 1,000 bushel-miles

From Figure III-6: the g.v.w. corresponding to the weighted average inverse energy efficiency of 1.065 gallons per 1,000 bushel-miles is 19,900 pounds.

equal to the average g.v.w. derived from the developed relationship of payload and g.v.w. (i.e. payload = .755 gross vehicle weight - 4.20)), where payload equals average box capacity (in bushels) multiplied by the weight of a typical bushel (i.e. 55 pounds), divided by one thousand (i.e. to convert pounds to kips). Accordingly, we have concluded that the following methods are acceptable for approximating the weighted g.v.w. (accounting for activity distribution by vehicle size) to employ in estimating average inverse transportation energy efficiency for private farm truck haul:

$$\text{Weighted Average g.v.w.} = \text{average licensed g.v.w.}$$

$$\text{or} \quad = \frac{\text{Avg. box capacity} \times 55}{.755 \times 1{,}000} + 4.20 \text{ (in kips)}$$

It is to be noted that in certain instances, observed data respecting average (licensed) g.v.w. and average box capacity, and more particularly, average bushel load, appear to be inconsistent* to a degree which necessitates judgment in choosing the method to employ in determining weighted average g.v.w.

In summary, for the private farm truck haul situation throughout the prairies, and using Tyrchniewicz's reported box capacity of 217.5 bushels, Kulshreshtha's reported average box capacity of 214 bushels and average g.v.w. of 19,940 pounds, we estimate that the weighted average (loaded) g.v.w. to be employed in the determination of average inverse transportation energy efficiency for private farm

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* In particular, the Tyrchniewicz data (Table 1) for Manitoba suggests an unreasonably low g.v.w., given the average bushel load.

trucked-grain is 19,920 pounds.* From Figure III-6, therefore, the average inverse transportation energy efficiency for private farm trucked-grain across the prairies is 1.07 gallons of gasoline per one thousand bushel-miles.

Custom-trucked grain is normally transported, as would be expected, in larger trucks than those used in private farm haul. Table III-5 presents the various shources of information available respecting their sizes. Given the shape of the inverse energy efficiency schedule over this size range of custom farm trucks, we have concluded that it is unnecessary to weight the size for purposes of determination of average inverse energy efficiency. Instead, from Table III-5, based on an approximate average box capacity in the prairies of 335 bushels, assumed loaded to 91 percent,** we estimate that an average loaded g.v.w. of 26,400 pounds*** is a reasonable basis to use in the approximation of average inverse energy efficiency for this element of farm-trucked grain. Based on this, from Figure III-6, the average inverse energy efficiency for custom farm-trucked grain (across the prairies) is 0.85 gallons of gasoline per one thousand bushel-miles, with a possible range from 0.77 to 0.94 gallons.

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* The simple average of 19,940, 20,040, and 19,790.

** Tyrchniewicz, Moore, Tangri - "The Cost of Transporting Grain by Custom and Commercial Truck" - 1974, p. 23.

*** $\frac{335 \times .91 \times 55}{.755 \times 1,000} + 4.2$ (in kips).

TABLE III-5

Custom Farm Truck Sizes in the Prairies

Source	Box Size (Bushels)	Comment
Kulshreshtha*	283	Average for areas B,C, & D
Kulshreshtha	410	Average for area A
Kulshreshtha	346	Average for all areas
Tyrchniewicz, Moore & Tangri**	327	However, average load equals 296 bushels, or 91 percent of capacity

* ibid. - Table 22

** "The Cost of Transporting Grain by Custom and Commercial Truck", Tyrchniewicz et al., 1974, p. 23.

For commercially-trucked grain, assuming a 75 thousand pounds loaded operation* from Table III-2 the average inverse transportation energy efficiency is 0.44 gallons of diesel per one thousand bushel-miles, with a possible range from 0.42 to 0.46.

For the rail mode, utilizing the data previously developed and presented, average inverse transportation energy efficiency is 0.09 gallons of diesel per one thousand bushel-miles.

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* This is one thousand pounds greater than normal weight limits but within normal tolerance policy respecting weight control. Discussions with weigh scale operators, and analysis of the S.T.A./ Canadian Wheat Board elevator to terminal haul, suggest that the 75 thousand pounds loaded state is normal.

FIGURE III-9

A MODAL COMPARISON OF
INVERSE TRANSPORTATION ENERGY EFFICIENCY
IN
GRAIN ASSEMBLY
ESTIMATED PRAIRIE AVERAGES

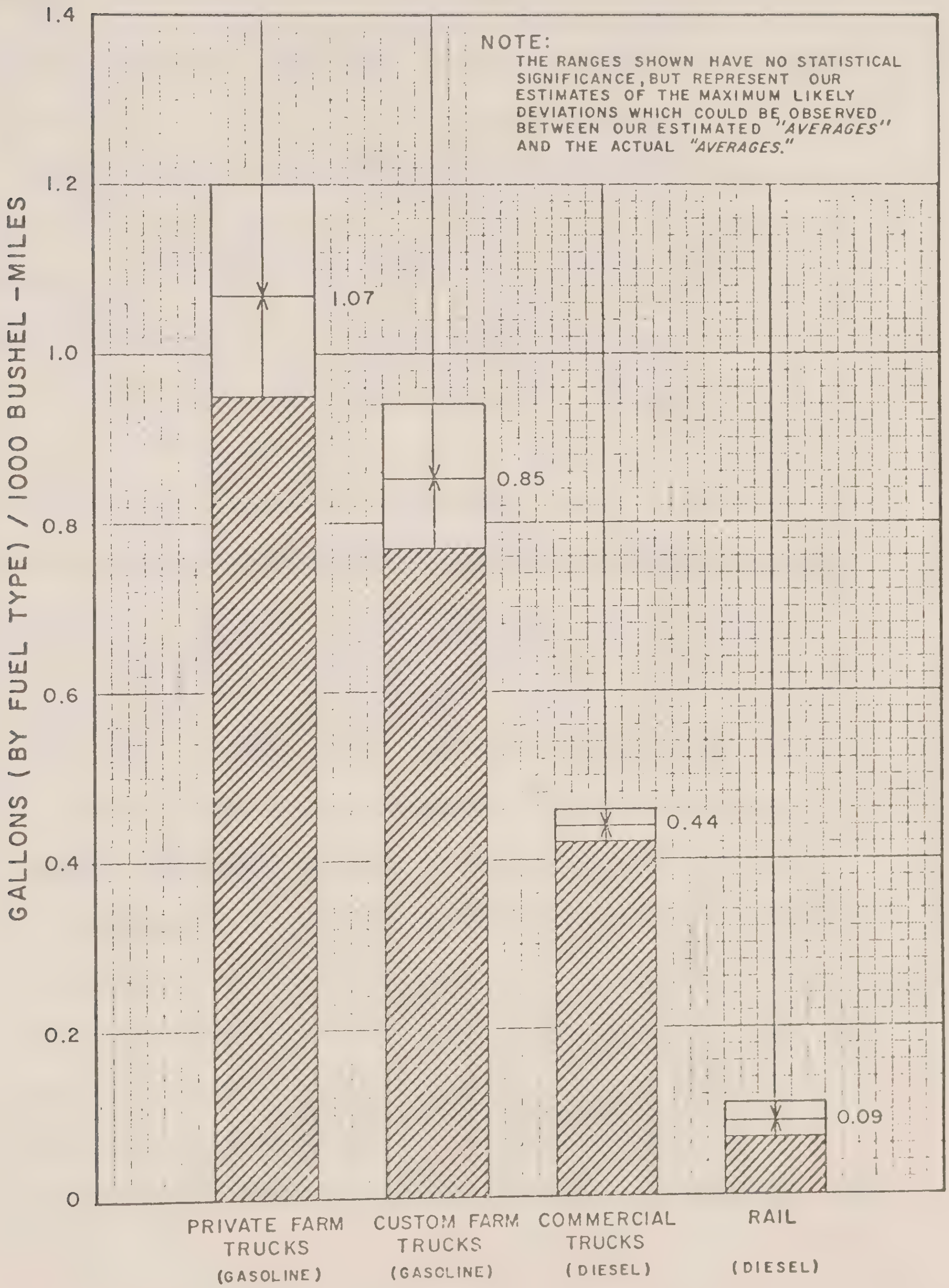

Figure III-9 illustrates these comparative rates for each mode. On a gallonage equivalency basis, the ratios of average truck inverse transportation energy efficiencies versus average rail efficiencies are:

Private farm truck vs. rail	11.9:1
Custom farm truck vs. rail	9.4:1
Commercial truck vs. rail	4.9:1

On a Btu equivalency basis*, these ratios become:

Private farm truck vs. rail	10.6:1
Custom farm truck vs. rail	8.5:1
Commercial truck vs. rail	4.9:1

FUEL COSTS AND GRAIN TRANSPORTATION IN WESTERN CANADA

The purpose of this section is to develop and present the basic data requirements and methodology for determining unit fuel prices applicable to grain haul in the prairies. The determination of the cost effects of adjustments in the grain transport system result from the application of these developed unit prices to estimated changes in consumption quantities.

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* Conversion Basis:

1 gallon gasoline = 149,200 Btu
1 gallon diesel = 166,500 Btu

Fuel Cost Factors

For the consumer, the price of gasoline and diesel fuel is made up of two components: the economic cost of the fuel, and the federal and provincial taxes added to fuel at points of production and sale.

The determinants of these two price components are, of course, different with the economic cost being basically a function of supply and demand (as influenced by tax policy), and the tax component being a function of public policy respecting user fees, cost transfers, and general revenue needs. For grain transport in the prairies, the experienced or financial cost of fuels to users varies by fuel type, mode and user type within the trucking mode, as will be shown. Accordingly, it is both useful and necessary to distinguish between these two price components in order that the differences between the relative changes in consumption levels and fuel costs resulting from rationalization may be understood as to their reason and significance.

Fuel Pricing: Method and Make-Up

a) Methodology

Petroleum refiners post selling prices of product, referred to as posted tank wagon prices, at various locations where they have bulk storage stations with product available for sale. These posted tank wagon prices include, in addition to crude oil and refining costs and profit: transportation charges from

the refinery to the bulk plant and from the bulk plant to the purchaser; bulk dealer mark-up; and applicable federal taxes. Posted tank wagon prices exclude applicable provincial taxes. All major refiners post tank wagon prices for three categories of sale: product destined to service station dealers; product destined to farm purchasers and home heating customers; and product destined directly to commercial consumers.

Posted tank wagon prices are considered to be "target prices". Many factors, such as sale volume, delivery distance, and customer storage facilities, can and do affect final delivered price - often for commercial users in a manner which renders delivered price something less than posted price. In determining final price, these factors are normally accounted for through discounts and contractual agreements negotiated between purchaser and selling agent. The relevance and size of discounts to various purchasers will be discussed later.

b) <u>Historic Trends in Posted Tank Wagon Prices in the Prairies</u>

A record of historic farm and commercial posted tank wagon prices for gasoline and diesel fuel at Edmonton, Calgary, Regina, and Winnipeg is presented in Table III-6. As shown, there has been a steady decrease in the posted price differentials between gasoline and diesel, from about 3.5 cents per gallon in 1967 to 2.4 cents per gallon in 1975.

TABLE III-6

Example Historic Posted Tankwagon Prices in the Prairies*

(cents/gallon)

	Edmonton/Calgary		Regina/Saskatoon		Winnipeg		Federal Sales Tax Included	
	Commercial	Farm	Commercial	Farm	Commercial	Farm	Gasoline	Diesel
Dec. 1967:								
Gasoline	22.5	21.5	23.4	22.4	23.4	22.4	2.1	1.6
Diesel	19.0	18.0	19.8	18.8	20.0	19.0		
Nov. 1969:								
Gasoline	23.2	22.2	24.1	23.1	24.1	23.1	2.1	1.6
Diesel	19.7	18.7	20.5	19.5	20.7	19.7		
Dec. 1970:								
Gasoline	24.2	23.2	25.1	24.1	25.1	24.1	2.1	1.6
Diesel	20.7	19.7	21.5	20.5	21.7	20.7		
Sept. 1971:								
Gasoline	25.2	24.2	26.1	25.1	26.1	25.1	2.5	2.4
Diesel	21.7	20.7	22.5	21.5	22.7	21.7		
June 1972:								
Diesel	22.7	21.7	23.5	22.5	23.7	22.7	2.5	2.4
Dec. 1973:								
Gasoline	29.0	28.0	29.9	28.9	29.9	28.9	2.7	2.7
Diesel	26.5	25.5	27.3	26.3	27.5	26.5		
Aug. 1974:								
Gasoline	38.9	37.9	39.8	38.8	39.8	38.8	3.3	3.1
Diesel	36.4	35.4	37.2	36.2	37.4	36.4		
Aug. 1975:								
Gasoline	46.5	45.5	47.4	46.4	42.0**	40.8	3.9	3.7
Diesel	44.0	43.0	44.8	43.8	39.6**	38.6		
Sept. 1975:								
Gasoline	46.6	45.5	47.5	46.4	41.9**	40.8**	3.9	3.7
	44.2	43.2	45.0	44.0	39.6**	38.6**		

* includes F.S.T.

** Price freeze in effect in Manitoba

c) Historic Trends in Federal and Provincial Fuel Taxes

Table III-7 summarizes historic data on Federal and Provincial taxes for gasoline and diesel fuel. It is to be noted that the general pattern of increasing provincial fuel tax rates was changed in 1974, with the prime objective of dampening the impact of rapid increases in world energy prices.

Federal sales taxes payable on motive fuels are constant across Canada. The present level of these taxes is: premium gasoline - 4.4 cents per gallon; regular and low-lead gasoline - 3.9 cents per gallon; and diesel oil - 3.7 cents per gallon. These taxes do not apply when fuel is used in a manufacturing process. In addition to these federal sales taxes, the Federal Government has recently instituted a ten cent per gallon excise tax on gasoline, refundable when used by a vehicle employed in business activity.

Provincial fuel taxes are comprised of two separate parts. A general fuel oil tax of three cents per gallon in Alberta, four cents per gallon in Saskatchewan, and five cents per gallon in Manitoba, is levied on all fuels (gasoline, diesel oil, fuel oil, etc.) except those used in vehicles properly registered as farm trucks. This general fuel oil tax is applicable to railway locomotive fuel purchases. In addition, a product tax is levied to create the overall provincial taxes indicated in Table III-7. Farm trucks are again exempt from this product tax as are railway locomotives. In Saskatchewan, under current tax regulations,

fuel used in farm vehicles (F-plated) as well as being exempt from provincial fuel taxes, is subject to a seven cent per gallon rebate grant. R-plated farm vehicles (i.e. normally but not always more than 2-axles) are subject to the provincial tax and do not receive the rebate.

TABLE III-7

Historic Federal and Provincial Gasoline and Diesel Taxes in the Prairies (cents/gallon)

	Federal Sales Tax		Provincial General Fuel and Product Taxes					
			Manitoba		Saskatchewan		Alberta	
	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel
1967	2.1	1.6	17.0	20.0	15.0	20.0	12.0	17.0
1968	2.1	1.6	17.0	20.0	15.0	20.0	12.0	17.0
1969	2.1	1.6	17.0	20.0	17.0	21.0	15.0	17.0
1970	2.1	1.6	17.0	20.0	19.0	21.0	15.0	17.0
1971	2.5	2.4	17.0	20.0	19.0	21.0	15.0	17.0
1972	2.5	2.4	17.0	20.0	19.0	21.0	15.0	17.0
1973	2.7	2.7	17.0	20.0	19.0	21.0	15.0	17.0
1974	3.3	3.1	15.0	18.0	12.0	16.0	10.0	12.0
1975	3.9	3.7	18.0	21.0	12.0	16.0	10.0	12.0

NOTES:

1) Farm vehicles are exempt from provincial fuel taxes. In Saskatchewan,fuel taxes are payable for R-plated farm trucks.

2) Farmers in Saskatchewan receive rebates of seven cents per gallon of gasoline and diesel.

3) Railway locomotives pay general fuel taxes at the following rates: Manitoba - 5 cents per gallon on diesel and gasoline; Saskatchewan - four cents per gallon on diesel and gasoline; Alberta - three cents per gallon on diesel and gasoline.

4) In Manitoba, in addition to the five cents per gallon general tax, the railways pay the product tax of 13 cents per gallon on gasoline, off-road use.

d) <u>Trends in Gasoline and Diesel Production and Transportation on the Prairies</u>

In recent years, there have been major adjustments in the location of petroleum refinery capacity in the prairies. Table III-8 destails operating capacities for individual refineries in the prairie region and summarizes refining capacity by province. At the end of 1975, Manitoba had only one refinery. Industry capacity had decreased by 36 percent over the past eight years. In Saskatchewan, industry capacity has decreased 53 percent over the same time period. In Alberta, refining capacity has increased by 88.4 percent between 1967 and 1975.

The prairie regions' total refining capacity was 322 thousand BPCD at the end of 1975, or 52.1 percent greater than in 1967. Alberta's share of total capacity has increased in eight years from 45.1 to 80.7 percent. These changes in capacity location will have pronounced effects on the source of diesel and gasoline supply for Saskatchewan and Manitoba, as well as on the determinants of price level and structure.

Complementing these adjustments in refining capacity location was the commencement, in 1972, of the transportation of refined petroleum products via the Interprovincial Pipeline Ltd. system running east from Edmonton. This system is now being used to transport refined products from Edmonton to Winnipeg (Gretna station), and is expected to soon be moving products as far east as the Lakehead.

TABLE III-8

Refinery Capacity in the Prairie Provinces
(Design Crude Oil Capacity - Barrels per Calendar Day)

Province and Refinery Owner	Location	1967	1970	1975	1975 (3)
Manitoba					
Gulf Oil Canada Ltd. (1)	Brandon	3,600	--	--	--
Imperial Oil Limited (2)	E. St. Paul	20,200	20,200	22,000	
Shell Canada Ltd.	St. Boniface	20,000	26,500	28,000	28,000
TOTAL MANITOBA		43,800	46,700	50,000	28,000
Saskatchewan					
Consumers Co-op	Regina	20,800	21,500	25,000	25,000
Gulf Oil Canada Ltd. (1)	Moose Jaw	13,500	13,500	9,300	9,300
Gulf Oil Canada Ltd. (1)	Saskatoon	7,450	7,450	--	--
Husky Oil Canada Ltd.	Moose Jaw	3,300	3,500	--	--
Imperial Oil Ltd.	Regina	27,400	28,800	31,300	--
TOTAL SASKATCHEWAN		72,450	74,750	65,600	34,300
Alberta					
Gulf Oil Canada Ltd. (1)	Calgary	9,000	9,000	8,700	8,700
Gulf Oil Canada Ltd. (1)	Edmonton	12,600	12,600	74,500	74,500
Husky Oil Canada Ltd.	Lloydminster	5,200	6,500	10,500	10,500
Imperial Oil Limited	Calgary	17,500	18,200	21,100	--
Imperial Oil Limited	Edmonton	32,000	33,000	39,000	140,000
Shell Canada Ltd.	Bowden	4,100	5,000	5,000	5,000
Texaco Canada Ltd.	Edmonton	15,000	18,000	21,000	21,000
		95,400	102,300	179,800	259,700
TOTAL PRAIRIES		211,650	223,750	295,400	322,000
Alberta as % of Prairies		45.1%	45.7%	60.9%	80.7%

SOURCE: Canadian Petroleum Magaxine Refining Issues July 1967, 1970, and 1975.

(1) Formerly British American Oil Co. Ltd.

(2) Now considered part of Winnipeg

(3) Reflects changes expected by the end of 1975 when Imperial Oils 140,000 barrel per day refinery comes on stream in Edmonton, Alberta

The growth of Edmonton as the major refining centre on the prairies, and the use of the Interprovincial Pipeline system for the transportation of refined product, leads to the general observation that the pricing of refined product out of Edmonton will be the fundamental base of energy fuel cost determination in the prairies.

Estimating Gasoline and Diesel Prices, by Mode and Location

a) Methodology

Oil companies post prices for the three classes of fuel trade discussed earlier at most of the population centres in the three prairie provinces. These posted prices are affected by many factors, and as a result, can lead to as many as thirty different price zones in a province. For the purposes of this study, it is considered unnecessary to attempt to fully describe the resulting detailed posted price schedules. Instead, a generalized method has been developed for calculating applicable fuel prices for a greatly reduced number of regional locations, utilizing previously developed energy costs and tax data. The method consists of: (i) the simple multiplication of the "Edmonton refining centre" energy cost by a transportation/competition factor to obtain a regional energy price at another location; (ii) a deduction from this factored price to account for trade discounts, where applicable, and (iii) the addition of applicable Federal and Provincial taxes to determine buyers' prices.

b) Fuel Cost Factors by Geographical Location

An analysis of posted prices has been carried out for a substantial number of centres in each of the three prairie provinces, in relation to comparable prices in Edmonton. These prices were related to the price at Edmonton in order to calculate a regional energy cost differential. The developed factors are presented in Table III-9. To establish the energy price at any of the indicated locations, the appropriate factor is applied to the Edmonton energy price.

The variations in energy prices, independent of taxes, over the prairie region is not extreme, with the maximum (Hudson Bay, Saskatchewan) being about 12 percent greater than the present Edmonton price. For locations not specifically indicated in Table III-9, a reasonable estimate can be obtained by applying the closest regional factor.

c) Relevant Considerations Respecting the Specific Determination of Farm Fuel Prices

The posted prices for farm customers include the cost of delivery from the bulk station to the farmer's storage facility. Discounts from these prices are rare. Farmers purchasing fuel at service stations effect increases in their fuel costs, because of the service station mark-up of six to ten cents per gallon. Mark-ups may be somewhat less at service stations which do not sell products identified by the brands and trademarks of the major oil companies.

TABLE III-9

Prairie Region Energy Cost Factors in Relation To Posted Tankwagon Prices at Edmonton

Alberta		Saskatchewan		Manitoba	
Edmonton-Calgary	1.00	Biggar	1.03	Brandon	1.06
Athabasca	1.06	Estevan	1.09	Dauphin	1.09
Banff	1.04	Hudson Bay	1.12	Erickson	1.08
Drumheller	1.05	Kindersley	1.10	Gretna	1.06
Ft. McMurray	1.10	Lloydminster	1.08	Killarney	1.07
Grande Prairie	1.06	Maple Creek	1.10	Melita	1.09
Jasper	1.09	Meadow Lake	1.10	Minnedosa	1.06
Lethbridge	1.07	Melfort	1.07	Portage La Prairie	1.05
Medicine Hat	1.08	North Battleford	1.08	Russel	1.10
Red Deer	1.04	Oxbow	1.07	Steinback	1.04
Spirit River	1.05	Prince Albert	1.09	Swan River	1.09
St. Paul	1.07	Regina - Moose Jaw - Saskatoon	1.02	Virden	1.08
Valleyview	1.08	Swift Current	1.09	Winnipeg	1.02
Wainwright	1.07	Weyburn	1.07		
		Yorkton	1.09		

As previously indicated, farmers at present do not pay provincial fuel taxes in the three prairie provinces. Farmers in Saskatchewan do get a grant from the Government of seven cents per gallon of gasoline or diesel*. However, they do not receive the rebate, and must pay provincial fuel tax on fuel consumed by R-plated farm vehicles.

d) Relevant Considerations Respecting the Specific Determination of Commercial Truckers' Fuel Prices

Larger trucking firms usually purchase diesel oil and gasoline at a negotiated contract price which fluctuates as the bulk dealers price fluctuates. If truckers have their own bulk tanks, or if they fill their trucks from the bulk dealers tanks, they usually receive discounts of two to three cents per gallon off the commercial customers price.

This discount, however, is available only for large quantity purchases. Small firms (i.e. one or two trucks) usually deal with a service station rather than a bulk dealer. Purchases by these companies will usually be at a discount of up to three cents from the retain price, but of course will include the service station mark-up for labor, storage, profit, etc. ranging from six cents to ten cents per gallon.

Very large fuel customers may obtain discounts of three to five cents per gallon of gasoline or diesel oil purchased. However,

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* In 1975, this rebate was available to a maximum of $200 per farmer. It is anticipated that some adjustment in this rebate program will be forthcoming shortly.

these firms invariably have their own large storage facilities capable of receiving large quantities per delivery.

Trucking firms whose units cover geographic areas which extend beyond the limits of the fuel-carrying capacity of their units must, of course, often purchase fuel at service stations. Frequently, however, they are able to obtain some discounts on these purchases, through volume-buying arrangements with the dealer's company.

e) Relevant Considerations Respecting the Specific Determination of Railway Fuel Prices

Railway fuel purchases are made in basically three ways: at refineries or pipeline terminals, wherefrom product is transported by rail to railway storage facilities; from bulk dealers, who deliver the product to railway storage facilities; and from bulk dealers, who deliver the product directly to locomotives on line.

CP Rail utilizes diesel oil in their locomotives, while CN has shifted to the use of Great Canadian Oil Sands tar sands semi-refined synthetic crude oil. Canadian National Railway has not provided detailed information on the cost of this synthetic crude, but has advised that because of its special nature, its price is higher than that of most synthetic crude, and is not significantly lower than diesel oil prices (after

discount)*.

Although no official information has been provided to this effect, it is understood that railway diesel fuel purchases are currently made at a discount of about ten cents per gallon from posted price, or about 30.5 cents per gallon at Edmonton. Comparing this with the synthetic crude price of 24.6 cents per gallon, and accepting the Canadian National Railway's comment that its particular synthetic crude is priced at a premium, there would appear to be some question as to Canadian National Railway's suggestion that the price differential between diesel and synthetic crude is only minor. However, for lack of more concrete price information, we are obliged to accept the proposition that both railways experience similar unit fuel prices as derived from posted diesel prices.

The railways purchase diesel oil on annual contracts at specified prices, subject to change on 30 days' notice. The diesel oil is purchased usually at the refinery, with subsequent transportation and storage being supplied by the railways at a cost ranging from one cent to two cents per gallon. This cost can vary considerably because of distance, and the number of inventory returns per year. Because of this additional storage

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* Cost data at Edmonton:

Crude Oil \$8.00/barrel = 22.9 cents per gallon
Synthetic Crude \$8.60/barrel = 24.6 cents per gallon
Diesel (Posted - excluding F.S.T.) \$14.17 barrel = 40.5 cents per gallon.

cost, a net discount from posted prices of 8.5 cents per gallon from regional prices appears reasonable for railway diesel used out of main rail line storage depots.

The railways purchase diesel oil for a substantial number of locations from bulk plants, delivering the diesel fuel into the locomotive's tanks. The amount purchased at these bulk plants ranges from about 13 thousand gallons per year to one million gallons per year, with the average being about 100 thousand gallons per year. Discounts off posted price range from three to six and one-half cents per gallon, and average about five cents per gallon. The bulk plant dealer applies a surcharge when delivery orders do not exceed a certain minimum or are made outside of normal business hours. Thse surcharges vary, some being levied on an hourly basis with others being levied on a gallonage basis. A discount of four cents per gallon from posted prices appears appropriate for bulk plant purchases of locomotive diesel.

Example Specific Price Determinations - By Mode and Location

For purposes of illustrating the methodology for estimating fuel prices, Table III-10 details the calculation of unit fuel prices applicable to specific situations (i.e. buyer and area).

A Modal Comparison of Inverse Transportation Fuel Cost Efficiencies for Grain Assembly in the Prairies

Variations in fuel costs between consuming modes and locations of purchase dictate that the conversion of modal consumption rates to

TABLE III-10

Example Fuel Price Determinations in the Prairies

(By Purchaser and Location)

(cents/gallon)

Determination of Energy Costs in 1975

Fuel Type	diesel	gasoline	diesel
Fuel Purchaser	railway	farmer	commercial trucker
Location	Carlton, Sask.	Brandon, Man.	Rockglen, Sask.
Edmonton Energy Price	40.5	41.6	40.5
Multiply by regional transport cost factor	1.08	1.06	1.07
Regional Energy Price	43.7	44.1	43.3
Less Discounts	10.0	0.0	3.0
Energy Cost to Buyer	33.7	44.1	40.3
ADD TAXES:			
Federal Sales Tax	3.7	3.9	3.7
Provincial Tax	4.0	0.0	16.0
TOTAL ENERGY PRICE	41.4	48.0	60.0

* Date of above calculations - December 30th, 1975.

modal fuel cost rates will create modal comparative ratios of fuel cost efficiency which differ from the comparable ratios of consumption efficiency as presented in the section on 'A modal comparison of inverse transportation energy efficiency'.

Figure III-10 illustrates the results of such a conversion for one particular case, utilizing the prairie average consumption rates developed in the aforementioned section, and modal fuel prices at

Saskatoon. From a total energy cost standpoint (including taxes/rebates), private farm trucks, custom farm trucks, commercial trucks, and rail expend 42.1 cents, 33.4 cents, 25.5 cents, and 3.5 cents of fuel per one thousand bushel-miles of haul, respectively*. (It is to be noted from Figure III-10 that, at present in Saskatchewan, an average one thousand bushels being moved one mile by a private farm truck effect a direct total government cost of 3.3 cents. The same one thousand bushels moved one mile by commercial truck generate a direct total government revenue of 8.7 cents. The net government gain to be realized per one thousand bushel-miles of haul tranferred from private farm truck to commercial truck is, therefore, 12 cents).

Utilizing these total cost figures, the fuel cost efficiency ratios, comparing one mode to the next at Saskatoon, are:

private farm truck vs. rail 12.0:1
custom farm truck vs. rail 9.9:1
commercial truck vs. rail 7.3:1

The comparable ratios as developed for Brandon, Manitoba and

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* For example - for the private farm truck:

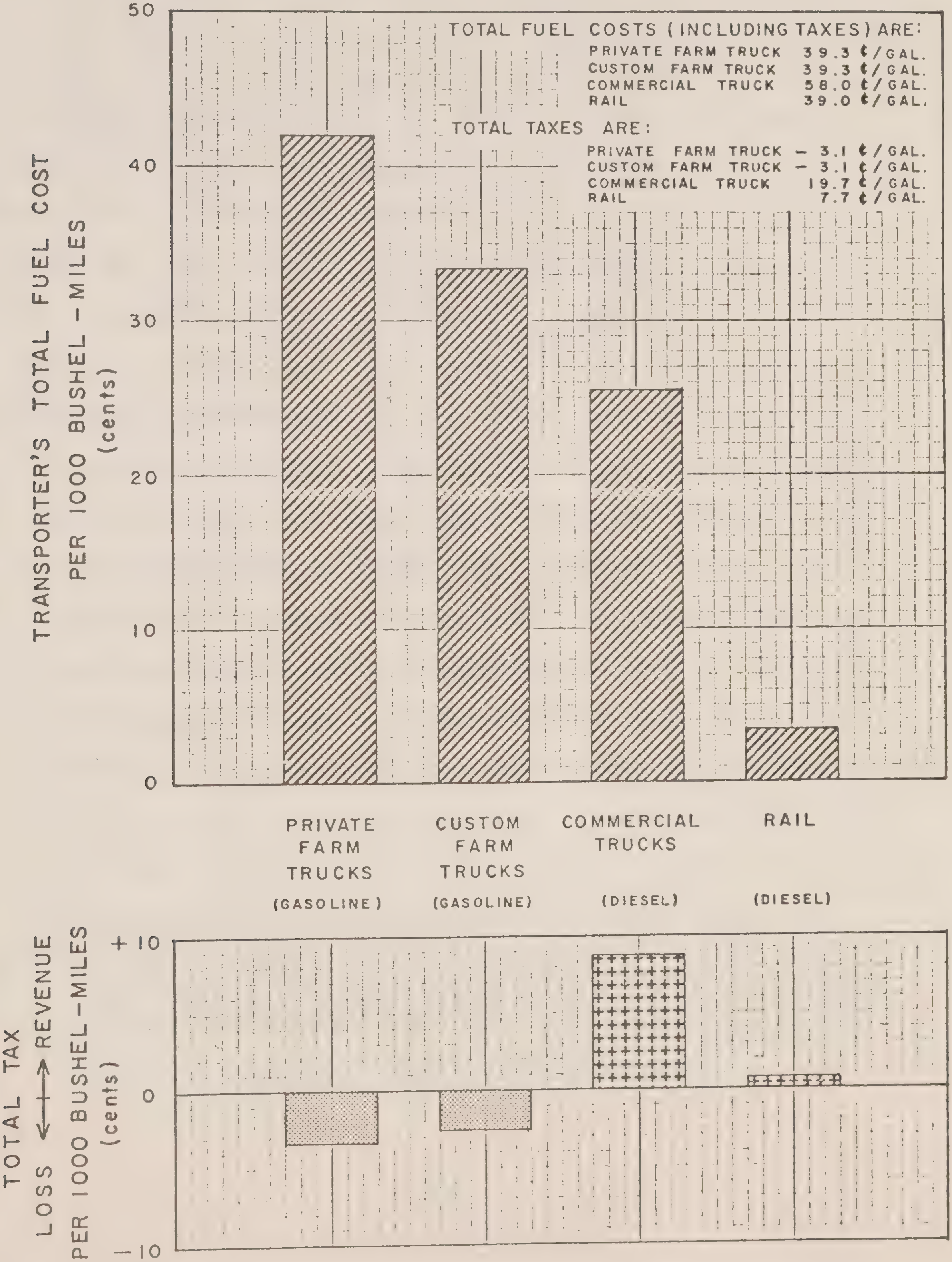
consumption = 1.07 gallons (gasoline) per 1,000 bushel-miles

price of gasoline (including F.S.T. and provincial rebate
= 39.3 cents per gallon

inverse transportation fuel cost efficiency = 1.07 x 39.3
= 42.1 cents per 1,000 bushel-miles.

FIGURE III-10

A MODAL COMPARISON OF TRANSPORTER'S TOTAL FUEL COSTS PER 1000 BUSHEL-MILES AND TOTAL TAX REVENUE (LOSS) PER 1000 BUSHEL-MILES AT SASKATOON - DEC. '75



Red Deer, Alberta, are:*

	Brandon	Red Deer
private farm truck vs. rail	15.2:1	12.8:1
custom farm truck vs. rail	11.0:1	11.5:1
commercial truck vs. rail	7.7:1	6.9:1

Over the prairies, it can be seen that the major difference between the ratios of modal fuel consumption efficiencies and modal fuel cost efficiencies is experienced by the commercial trucker, which enjoys neither the bulk purchasing power of the railways, nor the preferential tax treatment of the farmer (or custom farm trucker). In effect, while the commercial truck is 2.4 times as efficient as the private farm truck from the fuel consumption standpoint, while operating in grain assembly, it is only 1.8 times as efficient from the fuel cost standpoint. While fuel taxes account for less than 10 percent of fuel cost for farmers and railways, they account for one-third of the commercial truckers' fuel cost. The commercial trucker, of course, if the only road mode which contributes direct tax to provincial governments for road construction and maintenance (if it is assumed that the "general" provincial fuel taxes are not ear-marked for road expenditures).

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* In calculating these ratios, all consumption rates are the same as those discussed earlier herein except for private farm trucks which are estimated to be 1.17 and 0.95 gallons of gasoline per one thousand bushel-miles in Manitoba and Alberta respectively (equivalent to 17,800 and 22,450 pounds loaded direction g.v.w. respectively).

ASSESSMENT OF THE ENERGY IMPLICATIONS OF SPECIFIC BRANCH-LINE RATIONALIZATION

The comparative modal energy efficiencies developed in the third section do not, of course, onto themselves explain the energy implications of branch-line rationalization. In this regard, there are three other factors to account for:

(i) variations in the average size of farm trucks between areas;

(ii) variations in the mix of commercial, custom and private farm haul between specific cases; and

(iii) variations in the extent of rail and truck circuitousness between specific cases.

Specific Case Analysis

This section addresses the analysis of specific cases, wherein the before and after "scenarios" are defined, and the effects of the change are estimated. In each case, it has been assumed that the grain quantities are measured in typical bushels (as discussed previously), and the transportation equipment (i.e. trucks and railcars) is the same as that which has been used to develop the inverse transportation energy efficiency schedules and rates presented in the section on full costs and transportation in Western Canada. It has been further assumed that changes in producer haul distances are not accompanied with immediate adjustments in average vehicle size. Over time, of course, such adjustments could be expected to occur.

The following sections present detailed descriptions of each of the cases which have been analyzed, and the results of these analyses.

CASE 1A: Rationalization in the Brandon Area

1. Scenario (Equivalent to Alternative System No. 3 in the Canada Grains Council Study of the Brandon Area)

   a) General Statement

   This scenario assumes the removal of 270 miles of light traffic density rail lines and the closure of the elevators at the 25 delivery points on those lines. The producers re-direct their grain to the nearest elevators on the remaining basic rail network, using private farm trucks. Figure III-11 illustrates the before and after conditions of this scenario.

   b) Traffic Allocation Data Source

   Allocations of grain, and changes in truck mileage, are taken directly from the Brandon Area Study. (This study deals with grain deliveries in crop year '71-'72).

   c) Other Considerations

   The weighted average private farm truck size to be employed in determining average inverse transportation energy efficiency has been determined as follows:

$$\text{wt. avg. g.v.w.*} = \frac{\text{avg. box capacity} \times 55}{.755 \times 1{,}000} + 4.20 = 17.81 \text{ kips}$$

   where avg. box capacity = 186.8 bushels**

2. Calculations

   a) General

   It is assumed that all grain in the area is destined for the Lakehead, in both the pre and post abandonment states. While there are traffic shifts from one rail network to the other, it is assumed that these shifts are reconciled at Portage La Prairie, in such a manner as to render the effects of the change nil between Portage and the Lakehead.

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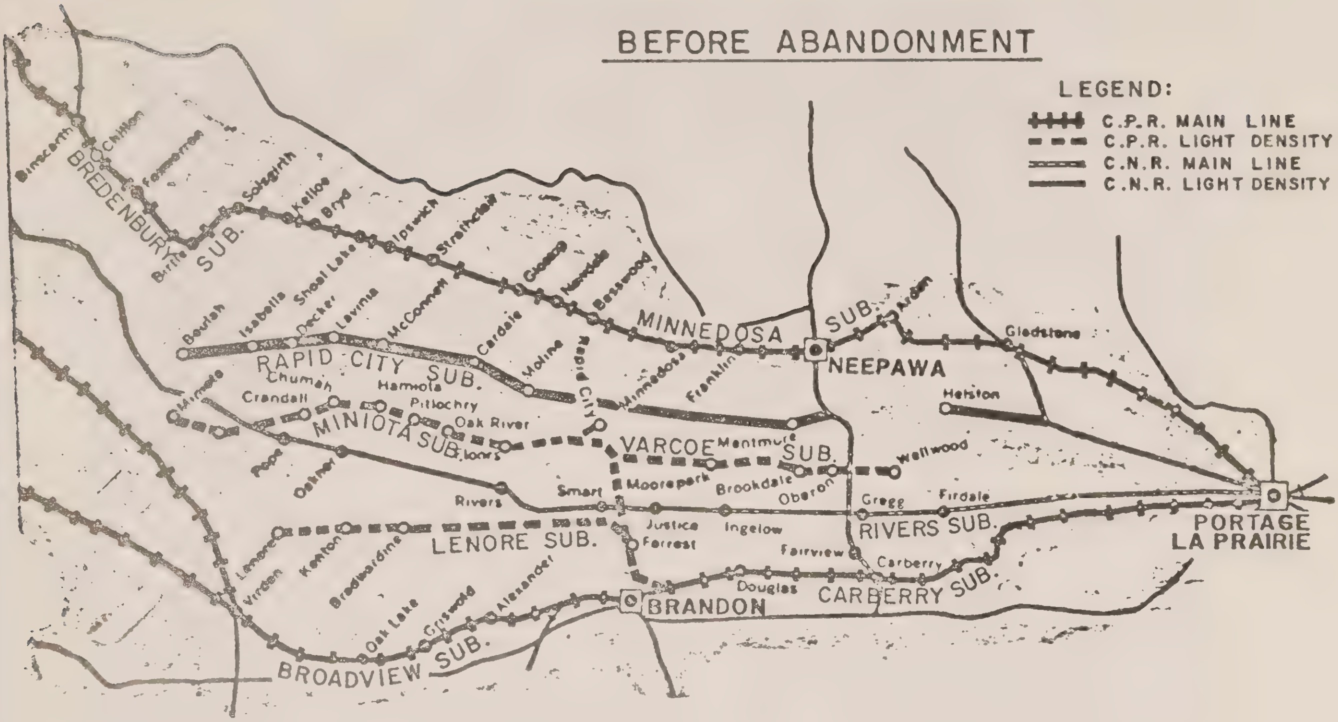
* See Section re: "A Modal Comparison of Inverse Transportation Energy Efficiencies...."

** Tyrchniewicz - ibid - Table 1 (Manitoba)

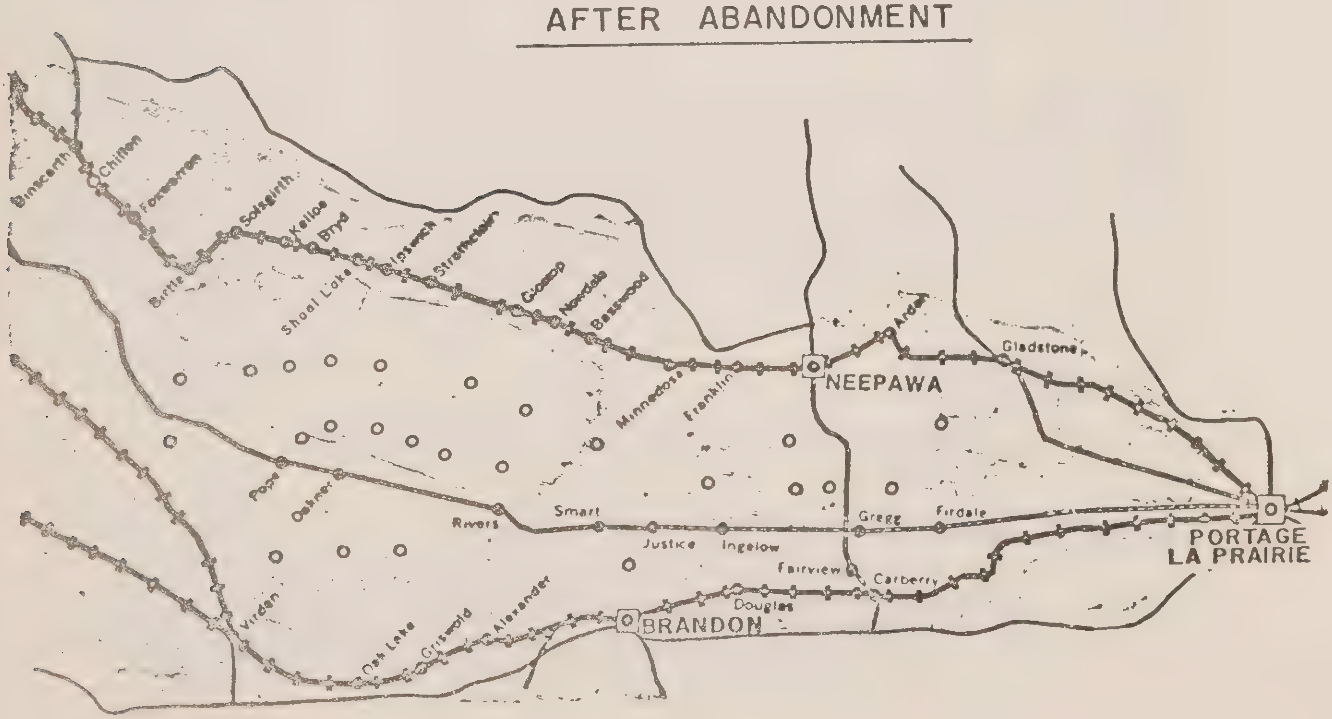
FIGURE III-11

RATIONALIZATION IN THE BRANDON AREA SCENARIO CASES 1A AND 1B

BEFORE ABANDONMENT



AFTER ABANDONMENT



ROUTING ASSUMPTION:

ALL AFFECTED GRAIN IS MOVED TO PORTAGE FROM THE RECEIVING ELEVATORS, AND THEN RECONCILED BETWEEN RAIL SYSTEMS PRIOR TO FURTHERANCE.

b) Bushel-Mile Implications for Rail

Tables III-11 and III-12 present detailed calculations of the changes in bushel-mile haulings experienced by the railways, between the pre and post abandonment states. The net rail effect (with reconciliation at Portage) is 147947 - 1000 bushel-miles DECREASE.

c) Bushel-Mile Implications for Truck

A shift in deliveries from elevators on the abandoned lines to elevators on the basic network increases haul distance for associated grains 4.2 miles (see Brandon Area Study, p. 18). The net truck effect is, therefore, 32201 - 1000 bushel-miles INCREASE (i.e. 7667 x 4.2).

3. Results - Estimated Fuel Consumption/Cost Implications

Table III-13 summarizes the estimated fuel consumption per cost implications of the defined scenario. The overall fuel requirement associated with grain assembly in the area would increase by about 25 thousand gallons per year. This increase in fuel consumption would add about 0.16 cents to the cost of delivery of each bushel produced in the area. The provincial Government would experience a small revenue loss (i.e. less than $1,000 per year), while the Federal Government would experience a small revenue gain (i.e. less than $1,000 per year).

CASE 1B: Rationalization in the Brandon Area

1. Scenario (Equivalent to CASE 1A, except that upon abandonment all grain originating with affected producers is shifted into commercial trucks for movement from farm to closest alternate elevator).

2. Calculations

a) General and Bushel-Mile Implications for Rail
See CASE 1A

b) Bushel-Mile Implications for Truck

Upon abandonment, affected producers cease trucking in farm vehicles. Pre-abandonment, their average haul distance is 4.9 miles (see Brandon Study, p. 13), with an average

TABLE III-11

Calculation of Bushel-Mile Losses for Rail Experienced For Scenario Case 1A

Delivery Points Experiencing Receipt Losses	Rail System	Rail Subdivision	Decreased Handling '000 bus.*	Rail Miles to Portage	1,000 Bushel-Miles
Beulah	CN	R. City	310	137.0	42,470
Bradwardine	CP	Lenore	327	115.9	37,899
Brookdale	CP	Varcoe	521	114.3	59,550
Cardale	CN	R. City	445	105.1	46,769
Chumah	CP	Miniota	63	133.3	8,398
Crandall	CP	Miniota	389	137.7	53,565
Decker	CN	R. City	356	125.8	44,785
Floors	CP	Miniota	204	114.8	23,419
Forrest	CP	Miniota	286	88.5	25,311
Golden Stream	CN	Gladstone	65	31.6	2,054
Hamiota	CP	Miniota	500	128.9	64,450
Helston	CN	Neepawa	261	38.3	9,996
Isabella	CN	R. City	384	129.9	49,882
Kenton	CP	Lenore	410	122.5	50,225
Lavinia	CN	R. City	237	120.8	28,630
Lenore	CP	Lenore	440	129.4	56,936
McConnell	CN	R. City	388	114.5	44,426
Mentmore	CN	R. City	263	68.3	17,963
Moline	CN	R. City	235	97.9	23,007
Moorepark	CP	Varcoe	296	104.2	30,843
Oak River	CP	Miniota	467	120.8	56,414
Oberon	CP	Varcoe	165	117.7	19,421
Rapid City	CP	R. City Spur	471	109.2	51,433
Wellwood	CP	Varcoe	184	124.5	22,908
TOTAL			7,667		870,754

* as derived from Table 5.1, Brandon Study, ibid.

TABLE III-12

Calculation of Bushel-Mile Gains for Rail Experienced For Scenario Case 1A

Delivery Points Experiencing Receipt Increases	Rail System	Rail Subdivision	Increased Handlings '000 bus.*	Rail Miles to Portage	1,000 Bushel-Miles
Alexander	CP	Broadview	13	93.2	1,212
Arden	CP	Minnedosa	36	50.9	1,832
Basswood	CP	Bredenbury	161	87.9	14,152
Brandon	CP	Broadview	6	77.5	465
Bryd	CP	Brendenbury	183	118.1	21,612
Birtle	CP	Bredenbury	188	137.1	25,775
Douglas	CP	Carberry	13	66.2	861
Firdale	CN	Rivers	154	36.5	5,621
Franklin	CP	Minnedosa	117	69.6	8,143
Gladstone	CP	Minnedosa	73	34.4	2,511
Glossop	CP	Bredenbury	191	100.7	19,234
Gregg	CN	Rivers	90	45.3	4,077
Griswold	CP	Broadview	67	102.3	6,854
Harte	CN	Rivers	285	52.5	14,963
Ingelow	CN	Rivers	429	58.9	25,268
Justice	CN	Rivers	295	67.4	19,883
Kelloe	CP	Bredenbury	140	122.5	17,150
McAuley	CP	Neudorf	10	161.1	1,611
Miniota	CN	Rivers	398	124.6	49,591
Minnedosa	CP	Minnedosa	26	77.9	2,025
Neepawa	CP	Minnedosa	112	60.3	6,754
Newdale	CP	Bredenbury	161	96.2	15,488
Oak Lake	CP	Broadview	127	109.5	13,907
Oakner	CN	Rivers	1,395	104.1	145,220
Petrel Junction	CN	Rivers	99	49.4	4,891
Pope	CN	Rivers	1,091	110.5	120,556
Rivers	CN	Rivers	521	87.9	45,796
Shoal Lake	CP	Bredenbury	175	114.3	20,003
Smart Siding (knox)	CN	Rivers	510	74.9	38,199
Solsqirth	CP	Bredenbury	128	129.1	16,525
Strathclair	CP	Bredenbury	331	105.5	34,921
Virden	CP	Broadview	142	124.7	17,707
TOTAL			7,667		722,807

* as derived from Table 5.9, Brandon Study, ibid.

TABLE III-13

Estimated Energy Implications

Scenario Case 1A

Applicable Inverse Efficiency Rate	0.09 gallons/1,000 bushel-miles	1.17 gallons/1,000 bushel-miles
Estimated Bushel-Mile Change/Year	-147,900 1,000 bushel-miles	+32,200 1,000 bushel-miles
Total Fuel Quantity Effect/Year	- 13,300 gallons	+37,700 gallons
Fuel Type	diesel	gasoline
Applicable Unit Price	41.6 cents/gallons	48.0 cents/gallon
Total User Cost Effect per Year	- $5,530	+ $18,100
Fuel Tax Effect Per Year	Fed. Gov't Loss $490 Prov. Gov't Loss $660	Fed. Gov't Gain $1,470 Prov. Gov't-no change

inverse transportation energy efficiency rate of 1.17 gallons (gasoline) per one thousand bushel-miles. Post-abandonment, commercial trucks operating at 74 thousand pounds g.v.w. carry out all haul in the area, over an average distance of 9.1 miles (i.e. 4.2 + 4.9).

3. Results - Estimated Fuel Consumption per Cost Implications

Table III-14 summarizes the estimated fuel consumption per cost implications of the defined scenario. The overall fuel requirement associated with grain assembly in the area would decrease by about 26 thousand gallons per year. This decrease in fuel consumption would reduce the cost of delivery of each bushel produced in the area by about 0.08 cents. The provincial Government would experience a revenue gain of about $6 thousand per year, while the federal Government would experience a small revenue loss (less than $1 thousand).

CASE 2A: Rationalization in the Carlton Area

1. Scenario

a) General Statement

This scenario assumes closure of Canadian National's Carlton Sub, and all elevators on the line. The producers re-direct their grain deliveries to the nearest elevators on the remaining basic rail network, using private farm trucks. Figure III-12 illustrates the before and after conditions of this scenario.

b) Traffic Allocation Data Source

Allocations of grain, and changes in truck mileage, are taken directly from Prairie Regional Study No. 10*. The data respecting the 1969-70 crop year presented in Study No. 10 is used in this particular analysis.

c) Other Considerations

The weighted average private farm truck size to be employed in determining the applicable average inverse transportation energy efficiency rate has been determined as follows:

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* Agriculture Canada, The Rosthern Region of Saskatchewan, 1972

TABLE III-14

Estimated Energy Implications

Scenario Case 1B

	MODE		
	Rail	Private Farm Truck	Commercial Truck
Applicable Inverse Efficiency Rate	0.09 gallons/1,000 bushel-miles	1.17 gallons/1,000 bushel-miles	0.45 gallons/1,000 bushel-miles
Estimated Bushel-Mile Change/Year	-147,900 1,000 bushel-miles	- 37,600* 1,000 bushel-miles	+ 69,800** 1,000 bushel-miles
Total Fuel Quantity Effect/Year	- 13,300 gallons	- 44,000 gallons	+ 31,400 gallons
Fuel Type	Diesel	gasoline	diesel
Applicable Unit Price	41.6 cents/gallon	48.0 cents/gallon	64.6 cents/gallon
Total User Cost Effect/Year	- $5,530	- $21,120	+ $20,280
Fuel Tax Effect/Year	Fed. Gov't Loss $490 Prov. Gov't Loss $660	Fed. Gov't Loss $1,720 Prov. Gov't Loss-no change	Fed. Gov't Gain $1,160 Prov. Gov't Gain $6,590

* 7,667 x 4.9

** 7,667 x 9.1

FIGURE III-12 RATIONALIZATION IN THE CARLTON AREA SCENARIO CASES 2A AND 2B

BEFORE ABANDONMENT

AFTER ABANDONMENT

ROUTING ASSUMPTION:

ALL AFFECTED GRAIN IS MOVED DIRECTLY TO LANGHAM JCT. FROM THE RECEIVING ELEVATORS, PRIOR TO FURTHERANCE, BOTH BEFORE AND AFTER ABANDONMENT.

$$\text{wt. avg. g.v.w.} = \frac{\text{avg. box capacity} \times 55}{.755 \times 1,000} + 4.20 = 19.8 \text{ kips}$$

where avg. box capacity = 214 bushels *.

This compares favourably with the average licensed g.v.w. of 19,940 pounds.

2. Calculations

a) General

It is assumed that all affected grain is moved directly to Langhan Junction from the receiving elevators, prior to furtherance, both before and after abandonment. Note that all diverted traffic remains on the Canadian National system. Grain diverted to the Blaine Lake Sub is assumed to be routed from Blaine Lake to Prince Albert to Langham Junction, for furtherance.

b) Bushel-Mile Implications for Rail

Table III-15 presents detailed calculations of the changes in bushel-mile haulings experienced by Canadian National between the pre and post abandonment states. The net rail effect is 2,720 - 1,000 bushel-miles DECREASE. It is to be noted from this Table that the relatively small amount of grain diverted to the Blaine Lake Sub (i.e. about one percent of the affected handlings) produces a bushel-mile impact of +12969, or nearly 27 percent of the total increased bushel-mile haulings from points experiencing increased handlings. This illustrates the possible significance of circuitous routing to fuel requirements. (In this particular instance, however, the magnitude of the numbers involved is relatively small, rendering the issue un-important).

c) Bushel-Mile Implications for Truck

A diversion of deliveries from elevators on the abandoned lines to elevators on the basic network increases haul

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* Kulshreshtha - ibid - Table 6 (Saskatchewan - All Areas)

TABLE III-15

Calculation of Bushel-Mile Changes Experienced by Rail for Scenario Case 2A

Delivery Points Experiencing Receipt Losses	Rail System	Rail Subdivision	Decreased Handlings '000 bus.*	Rail Miles to Langham Jct.	1,000 Bushel-Miles
Carlton	CN	Carlton	399	44.9	17,915
Laird	CN	Carlton	348	36.9	12,841
Waldheim	CN	Carlton	406	29.9	12,139
Hepburn	CN	Carlton	298	22.5	6,705
Mennon	CN	Carlton	108	15.7	1,696
TOTAL			1,559		51,296

* as derived from Table 4.2, Regional Study No. 10, ibid.

Delivery Points Experiencing Receipt Gains	Rail System	Rail Subdivision	Increased Handlings '000 bus.*	Rail Miles to Langham Jct.	1,000 Bushel-Miles
Osler	CN	Duck Lake	17	4.2	71
Langham	CN	Langham	57	16.8	958
Dalmeny	CN	Langham	272	8.9	2,421
Blaine Lake	CN	Blaine Lake	97	133.7	12,969
MacDowall	CN	Duck Lake	17	55.2	938
Rosthern	CN	Duck Lake	559	26.4	14,758
Duck Lake	CN	Duck Lake	362	37.9	13,720
Hague	CN	Duck Lake	178	15.4	2,741
TOTAL			1,559		48,576

* as derived from Table 4.2, Regional Study No. 10, ibid.

distances for associated grains as follows:

Diverted from Mennon	- Increase = 4.82 miles	
Diverted from Carlton	- Increase = 4.75 miles	
Diverted from Hepburn	- Increase = 7.50 miles	*
Diverted from Laird	- Increase = 9.69 miles	
Diverted from Waldheim	- Increase = 9.38 miles	

Grain quantities diverted from each of the abandoned delivery points are:

From Mennon	107,576 bushels	
From Carlton	399,477 bushels	
From Hepburn	298,256 bushels	**
From Laird	348,267 bushels	
From Waldheim	406,001 bushels	

Based on these figures, the net truck effect is an increase in haulage of 11835 - 1000 bushel-miles.

3. Results - Estimated Fuel Consumption Per Cost Implications

Table III-16 summarizes the estimated fuel consumption per cost implications of the defined scenario. The overall fuel requirement associated with grain assembly in the area would increase by about 12,400 gallons per year. This increase in consumption would add about 0.33 cents to the cost of delivery of each bushel produced in the area. The provincial Government would experience a small revenue loss (less than $1,000 per year), while the federal Government would experience a small revenue gain (less than $1,000 per year).

CASE 2B: Rationalization in the Carlton Area

1. Scenario

a) General Statement

This scenario assumes closure of Canadian National's Carlton Sub. All elevators remain open on the abandoned line, with producers continuing to haul to the elevators

* From Table 4.6 in Regional Study No. 10

** From Table 4.2 in Regional Study No. 10

in the same manner as in the pre-abandonment case. Grain is hauled from these elevators to the closest alternates in commercial grain trucks operating at 74 thousand pounds g.v.w.

b) Traffic Allocation Data Source

The Commercial trucks are assumed to divert grain as follows:

From Carlton to Duck Lake ...... 14 miles
From Laird to Rosthern .... 13 miles
From Waldheim to Rosthern ..... 15 miles
From Hepburn to Hague .... 12 miles
From Mennon to Dalmeny .... 7 miles

2. Calculations

a) Bushel-Miles Implications for Rail

Table III-17 presents detailed calculations of the changes in bushel-mile haulings experienced by Canadian National between the pre and post abandonment states. The net rail effect is 10718 - 1000 bushel-miles DECREASE.

b) Bushel-Mile Implications for Truck

There is no change in private farm truck haul. Increased haulage by commercial truck is 20542 - 1000 bushel-miles.

3. Results - Estimated Fuel Consumption per Cost Implications

Table III-18 summarizes the estimated fuel consumption per cost implications of the defined scenario. The overall fuel requirement associated with grain assembly in the area would increase by about 8,300 gallons per year. This increase in consumption would add about 0.33 cents to the cost of delivery of each bushel produced in the area. The provincial Government would experience a revenue gain of about $1,400 per year, and the federal Government would experience a small revenue gain (less than $1,000 per year).

TABLE III-16

Estimated Energy Implications
Scenario Case 2A

	Mode	
	Rail	Private Farm Truck
Applicable Inverse Efficiency Rate	0.09 gallons/1,000 bushel-miles	1.07 gallons/1,000 bushel-miles
Estimated Bushel-Mile Change/Year	- 2,700 1,000 bushel-miles	+ 11,800 1,000 bushel-miles
Total Fuel Quantity Effect/Year	-250 gallons	+ 12,600 gallons
Fuel Type	diesel	gasoline
Applicable Unit Price	41.4 cents/gallon	41.8 cents/gallon
Total User Cost Effect/Year	- $100	+ $5,270
Fuel Tax Effect/Year	Fed. Gov't Loss $10 Prov.Gov't Loss $10	Fed. Gov't Gain $490 Prov.Gov't Loss $880

TABLE III-18

Estimated Energy Implications
Scenario Case 2B

	Mode	
	Rail	Commercial Truck
Applicable Inverse Efficiency Rate	0.09 gallons/1,000 bushel-miles	0.45 gallons/1,000 bushel-miles
Estimated Bushel-Mile Change/Year	- 10,718 1,000 bushel-miles	+ 20,542 1,000 bushel-miles
Total Fuel Quantity Effect/Year	- 950 gallons	+ 9,250 gallons
Fuel Type	diesel	diesel
Applicable Unit Price	41.4 cents/gallon	60.4 cents/gallon
Total User Cost Effect/Year	-$390	+ $5,590
Fuel Tax Effect/Year	Fed. Gov't Loss $30 Prov.Gov't Loss $40	Fed. Gov't Gain $340 Prov.Gov't Gain $1,480

TABLE III-17

Calculation of Bushel-Mile Gains* Experienced By Rail
for
Schenario Case 2B

Delivery Points Experiencing Receipt Gains	Rail System	Rail Subdivision	Increased Handlings '000 bus.	Rail Miles to Langham Jct.	1,000 Bushel Miles
Duck Lake	CN	Duck Lake	399	37.9	15,122
Rosthern	CN	Duck Lake	754	26.4	19,906
Haugue	CN	Duck Lake	298	15.4	4,589
Dalmeny	CN	Langham	108	8.9	961
TOTAL			1,559		40,578

* Losses are same as for Case 2A

General Comments

From the results of the analysis of these specific rationalization scenarios, several observations can be drawn:

Firstly: For many of the branch-lines, the effects of abandonment on fuel consumption requirements of the railways will be relatively minor.

To illustrate, abandonment of 270 miles of track in the Brandon area would decrease fuel consumption associated with related rail grain assembly by about 13 thousand gallons per year, or one-half of the quantity of fuel consumed by a typical five-axle commercial highway truck in a year. Abandonment of the Carlton Sub would reduce railway fuel requirements by a quantity of fuel which is less than that consumed by one typical automobile in a year.

There are two basic reasons for this. Firstly, the unit inverse energy efficiency rate for rail is relatively small. Accordingly, large changes in bushel-mile haul must be experienced to effect significant quantity adjustments. Secondly, for many of the specific branch-line cases, traffic would be re-directed from the abandoned line to effectively paralleling lines, tending to minimize changes in bushel-mile rail haul. Of course, isolated cases of highly circuitous rail routing would not fall into this pattern.

Secondly: Given abandonment and the continued extensive employment of small private farm trucks, consumption could increase substantially

but would not necessarily do so.

In the case of the Brandon area, where current haul distances are short, extensive abandonment produced a net fuel increase equivalent to the amount of fuel consumed by one typical commercial highway truck in a year. In areas where the proximity to alternative rail lines is less, greater effects of course would be observed.

Thirdly: Given abandonment, the increases in fuel requirements which would be experienced by attendant increases in private farm truck haul could often be more than offset by shifting grain haul to large commercial trucks.

An objective of energy conservation in grain assembly could be oft times better served by encouraging shifts from the small private farm trucks to large trucks, in place of continued encouragement of the extensive employment of small private farm trucks. As was illustrated for the Brandon area, fairly extensive branch-line abandonment, if accompanied with wide-scale employment of large trucks, can produce overall fuel savings.

Fourthly: The government revenue implications of changes in fuel consumption effected by rationalization are relatively minor. Nontheless, it is interesting to note that provincial governments in particular can stand to gain revenue as a result of shifts from private farm truck haulage to commercial truck haulage of grain. As illustrated for the Brandon area, this

gain in provincial revenue can occur even under circumstances wherein overall fuel consumption decreases.

As an overall general comment, it is reasonable to observe that the magnitude of the energy implications of many of the rationalization options, particularly when accompanied with increases in the employment of large trucks in the place of small trucks, would be very minor, and indeed so small as to be effectively immeasurable and unpredictable. If energy conservation onto itself is to be viewed as an important argument favouring the retention of branch-lines, then in the same simplistic way, one should also argue, more strongly, for a significant shift from small private farm truck haul to large commercial truck haul of grain in the initial farm to elevator move. The first position only constrains <u>growth</u> in consumption, while the second position could effect <u>decreases</u> in consumption.

CONSIDERATION FOR THE FUTURE

This section addresses a number of general matters of relevance to fuel requirements and costs of grain assembly in the foreseeable future. Its purposes are to identify possible changes in regulation, technology, and fuel prices which could significantly alter the relative energy efficiency of one mode to the next while operating in grain assembly, and to generally comment on the implications of the changes.

Possible Developments in Regulation

a) Vehicle Weight and Dimension Regulations

In late 1974, the three prairie provinces entered a joint agreement with the Federal Government to upgrade the major highway network in the prairies (referred to as the primary highway system) to permit the operation of larger trucks than had theretofore been permitted. As a result of this developmental agreement, on designated highways, trucks are permitted to operate at gross vehicle weights up to 110 thousand pounds with 35 thousand pound tandem axles. Previous to the agreement, weight limits in the prairies were generally restricted to 74 thousand pound g.v.w., with 32 thousand pounds tandems. The effects of these increases have yet to be felt in the trucking of grain, exept in isolated circumstances, basically because of limitation in scope of the designated network.

If, as has been generally discussed, the scope of the network was to be increased, or more particularly, applied province and region wide, substantial improvements in the energy efficiency of commercially trucked grain could be realized. To illustrate, given that road haul could generally take place at 110 thousand pound g.v.w., the inverse transportation energy efficiency for grain haul on these large trucks

would be 0.35 gallons per one thousand bushel-miles,* or about one-fifth improved over the 74 thousand pound vehicle consumption requirement.

Increases in allowable truck lengths, unless accompanied with increased weight allowances, would not improve the energy efficiency of grain haul by large trucks (in that such trucks are nearly always "weighted-out", and not "bulked-out").

b) Speed Limit Decrease

There is currently substantial discussion about the possible decrease of speed limits across Canada to a maximum of 55 miles per hour. For the most part, such a decrease would effect no change in the fuel requirements of private farm trucks operating in grain assembly, in that most farm trucks in such operation average speeds substantially less than this proposed maximum. Such an adjustment, however, could alter somewhat the average consumption rates for large trucks. To illustrate, the average speed of semi-trailer truck units operating on primary highways in Saskatchewan is about 60 miles per hour.** For that portion of their activity on such

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* Assuming:
fuel performance = 4.0 m.p.g.
tare weight = 32 thousand pounds
payload = 110,000 - 32,000 = 78,000 lbs. or 1,418 typical bushels

$$\text{inverse efficiency} = \frac{0.5 \text{ gallons}}{1{,}418 \text{ bushel-miles}} = 0.35 \text{ gallons per one thousand bushel-miles.}$$

** See "Speeds on Saskatchewan Highways", published by the Saskatchewan Department of Highways.

roads, one may expect a reduction inoperating speed of commercial trucks by about five miles per hour to the proposed 55 miles per hour limit. Such an adjustment could be expected to improve fuel performance, and the inverse transportation energy efficiency rate by seven percent.**

Technological Developments

a) Railways

Probably the most important technological development in rail transport, which can produce foreseeable and significant improvements in rail fuel consumption associated with grain assembly, is the relatively recent introduction of high payload hopper cars, with roller bearings. In this regard, improvements would be derived primarily from the reduced resistance force per ton which must be overcome to move these units, relative to the old box-cars. Of course, there are branch-lines which are incapable of supporting the maximum loaded weight of these units, and in such instances no particular improvement is possible. Nonetheless, it is in order to expect that average inverse transportation energy efficiency of grain haul has improved, and will continue to improve, as more of these units are introduced into the system. (No firm data on the probable improvement in fuel efficiency resulting from the use of this equipment has been

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* R.R. Mayes: see footnote * next page

provided during this study).

b) Trucks

Mayes* briefly discusses a number of equipment developments designed to improve fuel performance in large trucks. There is, of course, much literature respecting detailed developmental possibilities in this regard, although it appears generally fair to observe that in the foreseeable future, there will be no large scale introduction of technological innovation which will substantially alter average energy efficiency of the truck mode operating in grain assembly**. This is particularly true for the private farm truck component of grain haul, for which there is a large physical plant already in existance that, regardless of technological development, would require substantial time to replace and modernize.

Fuel Price Developments

In the short term, no significant alternations are expected in the relative costs of fuel when comparing one mode operating in grain assembly to the next. This, of course, does not suggest that the absolute magnitude of fuel prices will not change. In this regard,

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* R.R. Mayes, "Energy and Trucking: An Examination of the Roles of Reason and Rhetoric in Modal Fuel Efficiency Studies", presented at the RTAC Conference in Calgary, September 1975.

** Discussions with commercial grain truckers in Saskatchewan indicate that there is always fairly wide-scale employment of light-weight grain-hoppers, and that accordingly payloads are about maximized.

obviously as prices increase, there are overall cost advantages to be reaped by encouraging, as possible, greater use of the more energy efficient modes, or mode elements.

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CHAPTER 4

THE IMPACT OF BRANCH LINE ABANDONMENT ON THE FISCAL VIABILITY OF LOCAL GOVERNMENTS

D.A. Neil

INTRODUCTION

An interesting aspect of Western Canadian history is the relationship between its railways and its settlement pattern. Since the rail network largely preceded the settlement of the area, the location of settlements, its organizations and institutions were greatly influenced and dependent upon the railways. It may be the awareness of this interrelationship that causes much of the opposition to rail line abandonment.

One group of institutions which were directly related to the rail network were the municipal governments of incorporated villages and towns and to a lesser extent, rural municipalities and school units.

One of the concerns of briefs put forward to the Grain Handling and Transportation Commission at the local hearings is the impact of rail line abandonment on the fiscal viability of local governments.

Purpose of the Study

The general purpose of this study is to determine the importance of local tax revenues derived from right-of-way properties.* The study attempts to determine:

1) the amount of tax assessment that incorporated communities and rural municipalities derive from right-of-way properties; and

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* Includes both railway and non railway properties.

2) the impact that the loss of right-of-way assessment would have on incorporated communities and rural municipalities with respect to:

   a) loss of tax assessment and levies;

   b) distributional effect of loss of right-of-way assessment;

   c) change required in municipal mill rates and school mill rates to maintain the present tax revenues.

Scope of Study and Assumptions

In assuming the effects of rail line abandonment, two levels of government are studied. These two levels of government are the local level and the school division. The local level includes both incorporated communities and rural municipalities. Taxpayers are subject to taxation from both these levels of government. The local level of government establishes the municipal mill rate based on the assessment within its administrative boundary. Similarly the school division establishes the school mill rate based on the assessment within its boundary. In general, a school division contains several incorporated communities and several rural municipalities (or portions of rural municipalities). As a result there are several tax jurisdictions or tax zones within a school district. A tax zone is defined as a separate geographic area with the same local government and school division jurisdictions. For example, a rural municipality may fall within two or more school divisions, thus, taxpayers in the same rural municipality but in different school divisions could face different mill rates (See figure IV-1).

Assumptions

In order to arrive at the findings in this study, several important assumptions were made. Firstly, it was assumed that when a rail line was closed, all tax assessment on the right-of-way would be lost including non-railway right-of-way assessment (i.e. grain elevators, bulk fuel dealers, etc.). Secondly, it was assumed that the assessed value of the right-of-way properties after abandonment would be zero since improvements would be removed or torn down and the right-of-way would have no alternative use. Thirdly, it was assumed there would be no increase or reduction in expenditures by either of the levels of government affected. As a result it was assumed that there would be no new expenditures on the road system which may be required because of longer grain hauling distances brought on by the loss of elevator service. Finally, it was assumed that there would be no assistance from any higher level of government to compensate for loss of tax revenues.

Data Collection

The tax assessment data collected were obtained from the Provincial Department of Municipal Affairs and incorporated communities tax assessment roles for 1975. Data for school district were collected from the Provincial Department of Education.

Study Area

-- Elrose Area

The rail lines studies in this area were:

1) the CP Rail McMorran Subdivision;

2) the CP Rail Matador Subidivision;

3) the CP Rail Kerrobert Subdivision*;

4) the Canadian National Elrose Subdivision**;

5) the Canadian National White Bear Subdivision;

6) the Canadian National Conquest Subdivision***.

The area encompasses eleven rural municipalities which fall within the boundaries of four school districts. Three towns and eleven villages are included in the study area.

Importance of Tax Assessment Derived from Right-of-Way Properties

Tax assessment of right-of-way properties would seem to be relatively more important to incorporated communities than to municipalities. The proportion of tax assessment of right-of-way properties to total tax assessment are shown in Table IV-1. Right-of-way properties in municipalities make up a very small proportion of the total tax assessment in the study area. They are in all cases less than five percent of the total. The proportion of the tax base relating to right-of-way properties usually diminishes as a community grows larger. This is readily apparent in a comparison of the proportion of tax assessment of small and large communities. For example in the Elrose area, the

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* Includes only that portion of the Kerrobert Subdivision from Milden to Conquest. This portion of the Kerrobert Subdivision is part of the basic network.

** Includes only that portion of the Elrose Subdivision from Tichfield to Glidden.

*** Includes only that portion of the Conquest Subdivision from Conquest to Beechy.

TABLE IV-1 PROPERTY TAX ASSESSMENT FOR MUNICIPALITIES AND INCORPORATED COMMUNITIES, 1975

ELROSE AREA

	Railway Right-of-way Tax Assessment	Non Railway Right-of-way Tax Assessment	Total Right-of-way Tax Assessment	Total Tax Assessment	Percent of Total Tax Assessment Derived From R.O.W. Properties
MUNICIPALITIES	$	$	$	$	
225 Canaan	9,050	NIL	9,050	1,661,510	0.54%
226 Victory	6,820	45,360	52,180	2,965,670	1.76%
228 Lacadena	49,190	305,870	355,060	7,379,780	4.81%
255 Coteau	27,660	55,370	83,030	2,003,000	4.15%
256 King George	NIL	NIL	NIL	1,851,290	0.00%
257 Monet	64,710	211,800	276,510	6,488,660	4.26%
259 Snipe Lake	54,080	257,350	311,430	9,051,080	3.44%
260 Newcombe	22,840	28,940	51,780	3,810,640	1.36%
285 Fertile Valley	51,450	90,140	141,590	3,766,164	3.76%
286 Milden	26,100	30,380	56,480	4,293,760	1.32%
287 St. Andrews	46,360	94,390	140,750	4,929,450	2.86%
INCORPORATED COMMUNITIES					
Elrose	15,000	110,700	125,700	1,085,940	11.58%
Eston	30,750	236,120	266,870	2,551,670	10.46%
Kyle	8,140	84,150	92,290	985,530	9.36%
Beechy	7,270	152,620	159,890	638,660	25.04%
Birsay	4,250	44,780	49,030	171,110	28.65%
Bounty	3,820	7,040	10,860	86,780	12.51%
Conquest	13,250	59,230	72,480	361,040	20.08%
Dinsmore	11,470	162,280	173,750	826,510	21.02%
Lucky Lake	9,630	91,080	100,710	594,180	16.95%
Macrorie	7,090	39,610	46,700	173,930	26.85%
Madison	5,130	74,610	79,740	155,190	51.38%
Milden	6,680	106,410	113,090	469,880	24.07%
Plato	3,660	46,920	50,580	121,290	41.70%
Wiseton	5,630	79,050	84,680	310,095	27.31%

proportion of tax assessment of right-of-way properties at Madison (population 58) is 51.38 percent of the total assessment, while at Eston (population 1,418) right-of-way assessment represents only 10.46 percent of the total assessment. This relationship reflects the greater economic activity at larger centres. In general, the proportion of right-of-way assessment diminishes as the total assessment of the taxing authority increases.

DISTRIBUTIONAL EFFECTS

Impact of Loss of Right-Of-Way Assessment

A significant aspect in studying the importance of local tax revenues derived from right-of-way properties is the distributional effects that loss of right-of-way assessment will cause. Most studies in the past have just considered the loss of assessment by local governments and have ignored the distributional effects.

A distributional effect could be defined as a change in mill rates which is not proportionate to the change in the taxing authorities' loss of assessment. In all cases, there will be a distributional effect between incorporated communities and rural municipal districts. In Saskatchewan, there will be an additional distributional effect within some rural municipalities in those cases where taxpayers in the same municipality experience different total mill rate increases because their municipality falls within different school divisions. The school divisions will have to adjust their school mill rates differently

depending on the loss of assessment within their boundaries, whereas the change in the municipal mill rate will be constant throughout the municipality.

THE ELROSE AREA

Alternative 1

The description of the railway subdivisions in the area have previously been discussed. For purposes of Alternative 1, it was assumed that the Elrose, White Bear, Matador, McMorran and Conquest Subdivisions would be closed. Table IV-2 shows the amount of right-of-way assessment that would be lost. As stated earlier, it was assumed for purposes of this study that in the event of closure of a rail line, all other right-of-way assessments would be lost. The largest projected loss of assessment occurs in the R.M. of Lacadena. This loss is $355,060 and represents 4.8 percent of the total assessment and a loss of $30,713 of tax levy*. In Alternative 1, all but three municipalities, Fertile Valley, Milden and St.Andrews lose 100 percent of their right-of-way assessment. The largest loss of tax levy also occurs in the municipality of Lacadena. The largest percentage loss of assessment in communities occurs at Madison, $79,740 or 51.4 percent of the total assessment

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* Loss of tax levy is the loss of assessment times the total mill rate. See Table IV-4 for the loss of tax levies.

TABLE IV-2 - LOSS OF TAXABLE ASSESSMENT BY TAXING AUTHORITY AND PROJECTED SCHOOL AND MUNICIPAL MILL RATES

ALTERNATIVE 1	TOTAL TAX ASSESSMENT	ESTON-ELROSE SCHOOL UNIT TAXAB ASSESSMENT	ESTON-ELROSE SCHOOL UNIT LOSS OF TAXABLE ASSESSMENT	ESTON-ELROSE SCHOOL UNIT PROJECTED TAXABLE ASSESSMENT	OUTLOOK SCHOOL UNIT TAXABLE ASSESSMENT	OUTLOOK SCHOOL UNIT LOSS OF TAXABLE ASSESSMENT	OUTLOOK SCHOOL UNIT PROJECTED TAXABLE ASSESSMENT	ROSETOWN SCHOOL UNIT TAXABLE ASSESSMENT	ROSETOWN SCHOOL UNIT LOSS OF TAXABLE ASSESSMENT	ROSETOWN SCHOOL UNIT PROJECTED TAXABLE ASSESSMENT	PROJECTED TOTAL TAX ASSESSMENT	PRESENT MUNICIPAL MILL RATE	PROJECTED MUNICIPAL MILL RATE
MUNICIPALITIES													
225 Canaan	1,661,510	-	-	-	1,661,510	9,050	1,652,460	-	-	-	1,652,460	52.5	52.8
226 Victory	2,965,670	201,720	-	201,720	2,524,450	52,180	2,472,270	-	-	-	2,913,490	44.2	45.0
228 Lacadena	7,379,780	7,379,780	355,060	7,024,720	-	-	-	-	-	-	7,024,720	40.5	42.5
255 Coteau	2,003,000	-	-	-	2,003,000	83,030	1,919,970	-	-	-	1,919,970	45.0	46.9
256 King George	1,851,290	1,581,020	-	1,581,020	270,270	-	270,270	-	-	-	1,851,020	40.0	40.0
257 Monet	6,488,660	6,373,110	276,510	6,096,600	-	-	-	115,550	-	115,550	6,212,150	31.9	33.3
259 Snipe Lake	9,051,080	9,051,080	311,430	8,739,650	-	-	-	-	-	-	8,739,650	41.0	42.5
260 Newcombe	3,810,640	1,005,434	5,600	999,834	-	-	-	-	-	-	3,758,860	43.5	44.1
285 Fertile Valley	3,766,164	709,326	11,260	698,066	2,735,594	121,430	2,614,164	316,094	-	316,094	3,633,474	37.2	38.6
286 Milden	4,293,760	1,310,130	29,590	1,280,540	-	-	-	2,983,630	15,880	2,967,750	4,248,290	39.5	39.9
287 St. Andrews	4,929,450	134,360	-	134,360	-	-	-	4,795,090	84,090	4,711,000	4,845,360	38.0	38.7
288 Pleasant Valley	-	-	-	-	-	-	-	2,413,835	-	2,413,835	N.A.	N.A.	N.A.
Other R.M's	-	-	-	-	5,938,261	4,000	5,934,261	14,547,350	-	14,547,350	-	-	-
Sub-Total	-	27,745,960	989,450	26,756,510	15,133,085	279,770	14,853,315	25,171,549	99,970	25,071,579	-	-	-
INCORPORATED COMMUNITIES													
Elrose	1,085,940	1,085,940	125,700	960,240	-	-	-	-	-	-	960,240	36.0	40.7
Eston	2,551,670	2,551,670	266,870	2,284,800	-	-	-	-	-	-	2,284,800	49.0	54.7
Kyle	985,530	985,530	92,290	893,240	-	-	-	-	-	-	893,240	39.0	43.0
Beechy	638,660	-	-	-	638,660	159,890	478,770	-	-	-	478,770	47.0	62.7
Birsay	171,110	-	-	-	171,110	49,030	122,080	-	-	-	122,080	43.0	60.3
Bounty	86,780	-	-	-	86,780	-	86,780	-	-	-	86,780	30.0	30.0
Conquest	361,040	-	-	-	361,040	8,240	352,800	-	-	-	352,800	34.2	35.0
Dinsmore	826,510	826,510	173,750	652,760	-	-	-	-	-	-	652,760	38.0	48.1
Lucky Lake	594,180	-	-	-	594,180	100,710	493,470	-	-	-	493,470	43.0	51.8
Macrorie	173,930	-	-	-	173,930	46,700	127,230	-	-	-	127,230	30.0	41.0
Madison	155,190	155,190	79,740	75,450	-	-	-	-	-	-	75,450	28.0	57.6
Milden	469,880	-	-	-	-	-	-	469,880	-	469,880	469,880	32.0	32.0
Plato	121,290	121,290	50,580	70,710	-	-	-	-	-	-	70,710	30.0	51.4
Wiseton	310,095	84,680	225,415	-	-	-	-	-	-	-	225,415	42.0	57.8
Others	-	-	-	-	4,442,400	-	4,442,400	7,845,280	-	7,845,280	-	-	-
Sub-Total	-	6,036,225	873,610	5,162,615	6,468,100	364,570	6,103,530	8,315,160	-	8,315,160	-	-	-
TOTAL	-	33,782,185	1,863,060	31,919,125	21,601,185	634,260	70,966,925	33,486,709	99,970	33,386,739	-	-	-
Present School Mill Rate		46.0			39.0			45.0					
Projected School Mill Rate		48.7			40.2			45.1					

and $5,901 in loss of tax levy, while the largest absolute loss is at Eston where the loss of assessment is $266,870 or 10.5 percent of the total assessment and $25,353 in loss of tax levy (at 1975 mill rate).

Table IV-2 also presents the total assessments and loss of assessment brought about by the removal of rail lines, for each municipality, community and school unit in the study area. Present school and municipal mill rates are also shown.

The change in the municipal portion of the total mill rate is proportionate to the change in total assessment in the municipality or incorporated community. The change in total assessment is the difference between the total assessment and the projected total assessment. (Projected Mill Rate = Present Total Assessment/Projected Total Assessment x Present Mill Rate). The projected municipal mill rate for each municipality and community is calculated by dividing the present total assessment of a municipality or community by the projected total assessment and multiplying that figure by the present municipal mill rate (Table IV-3).

The change in the school portion of the total mill rate is proportionate to the change in assessment in the school unit. Incorporated communities always lie within one school unit, however, several of the municipalities lie within more than one school unit. Thus, when calculating the projected total mill rates, different parts of a municipality will have different total mill rates depending upon which school unit they lie within. Table IV-2 shows that loss in taxable

assessment of each school unit brought about by the loss of assessment of municipalities and communities within each school unit. The projected school mill rate for each school unit and therefore for each community and portion of a municipality in that school unit is calculated by dividing the present total assessment of the school unit by the projected total assessment and multiplying that figure by the present school mill rate. (Table IV-3).

Figure IV-1 shows the increase in mill rate for each tax zone in the study area. The largest increase in the total mill rate in a rural municipality was in Lacadena which increased 4.7 mills or 5.4 percent. The municipality of Lacadena is in the Eston-Elrose school unit. The largest increase in the total mill rate of a community was at Madison where the projected mill rate rose 32.3 mills or 43.6 percent.

Some of the more interesting distributional effects upon the mill rate in Alternative 1 are as follows:

1) R.M. of King George, No. 225. There are no railways running through the municipality and therefore no loss of assessment. Thus the municipal portion of the total mill rate does not change. However, part of 225 King George is in the Eston-Elrose school unit while the remainder is in the Outlook school unit. For the taxpayers of King George living in the Eston-Elrose school unit, their mill rate would increase by 2.7 mills and for those in the Outlook school unit there would be a 1.2 mill increase.

2) Village of Milden. Milden does not lose any tax assessment, thus its municipal portion of the total mill rate does not change. Milden is in the Rosetown school unit and because of the loss of assessment in the school unit, the school portion of the total mill rate is increased by 0.1 mills.

TABLE IV-3

PRESENT AND PROJECTED MILL RATES OF MUNICIPALITIES AND INCORPORATED COMMUNITIES BY SCHOOL UNITS, BASIS 1975.

	ESTON - ELROSE SCHOOL UNIT			OUTLOOK SCHOOL UNIT			ROSETOWN SCHOOL UNIT		
ALTERNATIVE 1	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %
MUNICIPALITIES									
225 CANAAN									
school	-	-	-	39.0	40.2	3.1	-	-	-
municipal	-	-	-	52.5	52.8	0.6	-	-	-
TOTAL	-	-	-	91.5	93.0	1.6	-	-	-
226 VICTORY									
school	46.0	48.7	5.9	39.0	40.2	3.1	-	-	-
municipal	44.2	45.0	1.8	44.2	45.0	1.8	-	-	-
TOTAL	90.2	93.7	3.9	83.2	85.2	2.4	-	-	-
228 LACADENA									
school	46.0	48.7	5.9	-	-	-	-	-	-
municipal	40.5	42.5	4.9	-	-	-	-	-	-
TOTAL	86.5	91.2	5.4	-	-	-	-	-	-
255 COTEAU									
school	-	-	-	39.0	40.2	3.1	-	-	-
municipal	-	-	-	45.0	46.9	4.2	-	-	-
TOTAL	-	-	-	84.0	87.1	3.7	-	-	-
256 KING GEORGE									
school	46.0	48.7	5.9	39.0	40.2	3.1	-	-	-
municipal	40.0	40.0	0.0	40.0	40.0	0.0	-	-	-
TOTAL	86.0	88.7	3.1	79.0	80.2	1.5	-	-	-
257 MONET									
school	46.0	48.7	5.9	-	-	-	45.0	45.1	0.2
municipal	31.9	33.3	4.4	-	-	-	31.9	33.3	4.4
TOTAL	77.9	82.0	5.3	-	-	-	76.9	78.4	2.0

PRESENT AND PROJECTED MILL RATES OF MUNICIPALITIES AND INCORPORATED COMMUNITIES BY SHCOOL UNITS, BASIS 1975.

	ESTON - ELROSE SCHOOL UNIT			OUTLOOK SCHOOL UNIT			ROSETOWN SCHOOL UNIT		
	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %
MUNICIPALITIES									
259 SNIPE LAKE									
school	46.0	48.7	5.9	-	-	-	-	-	-
municipal	41.0	42.5	3.7	-	-	-	-	-	-
TOTAL	87.0	91.2	4.8	-	-	-	-	-	-
260 NEWCOMBE									
school	46.0	48.7	5.9	-	-	-	-	-	-
municipal	43.5	44.1	1.4	-	-	-	-	-	-
TOTAL	89.5	92.8	3.7	-	-	-	-	-	-
285 FERTILE VALLEY									
school	46.0	48.7	5.9	39.0	40.2	3.1	45.0	45.1	0.2
municipal	37.2	38.6	4.0	37.2	38.6	4.0	37.2	38.6	4.0
TOTAL	83.2	87.3	4.9	76.2	78.8	3.4	82.2	83.7	1.8
286 MILDEN									
school	46.0	48.7	5.9	-	-	-	45.0	45.1	0.2
municipal	39.5	39.9	1.0	-	-	-	39.5	39.9	1.0
TOTAL	85.5	88.6	3.6	-	-	-	84.5	85.0	0.6
287 ST. ANDREWS									
school	46.0	48.7	5.9	-	-	-	45.0	45.1	0.2
municipal	38.0	38.7	1.8	-	-	-	38.0	38.7	1.8
TOTAL	84.0	87.4	4.0	-	-	-	83.0	83.8	1.0
288 PLEASANT VALLEY[1]									
school	-	-	-	-	-	-	45.0	45.1	0.2
municipal	-	-	-	-	-	-	-	-	0.0
TOTAL	-	-	-	-	-	-	45.0	45.1	0.2

1 The municipality of Pleasant Valley is representative of those municipalities within the Rosetown School Unit where the municipal mill rate is unaffected.

PRESENT AND PROJECTED MILL RATES OF MUNICIPALITIES AND INCORPORATED COMMUNITIES BY SCHOOL UNITS, BASIS 1975.

	ESTON - ELROSE SCHOOL UNIT			OUTLOOK SCHOOL UNIT			ROSETOWN SCHOOL UNIT		
	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %
INCORPORATED COMMUNITIES									
ELROSE									
school	46.0	48.7	5.9	-	-	-	-	-	-
municipal	36.0	40.7	13.1	-	-	-	-	-	-
TOTAL	82.0	89.4	9.0	-	-	-	-	-	-
ESTON									
school	46.0	48.7	5.9	-	-	-	-	-	-
municipal	49.0	54.7	11.6	-	-	-	-	-	-
TOTAL	95.0	103.4	8.8	-	-	-	-	-	-
KYLE									
school	46.0	48.7	5.9	-	-	-	-	-	-
municipal	39.0	43.0	10.3	-	-	-	-	-	-
TOTAL	85.0	91.7	7.9	-	-	-	-	-	-
BEECHY									
school	-	-	-	39.0	40.2	3.1	-	-	-
municipal	-	-	-	47.0	62.7	33.4	-	-	-
TOTAL	-	-	-	86.0	102.9	19.7	-	-	-
BIRSAY									
school	-	-	-	39.0	40.2	3.1	-	-	-
municipal	-	-	-	43.0	60.3	40.2	-	-	-
TOTAL	-	-	-	82.0	100.5	22.6	-	-	-
BOUNTY									
school	-	-	-	39.0	40.2	3.1	-	-	-
municipal	-	-	-	30.0	30.0	0.0	-	-	-
TOTAL	-	-	-	69.0	70.2	1.7	-	-	-

PRESENT AND PROJECTED MILL RATES OF MUNICIPALITIES AND INCORPORATED COMMUNITIES BY SCHOOL UNITS, BASIS 1975.

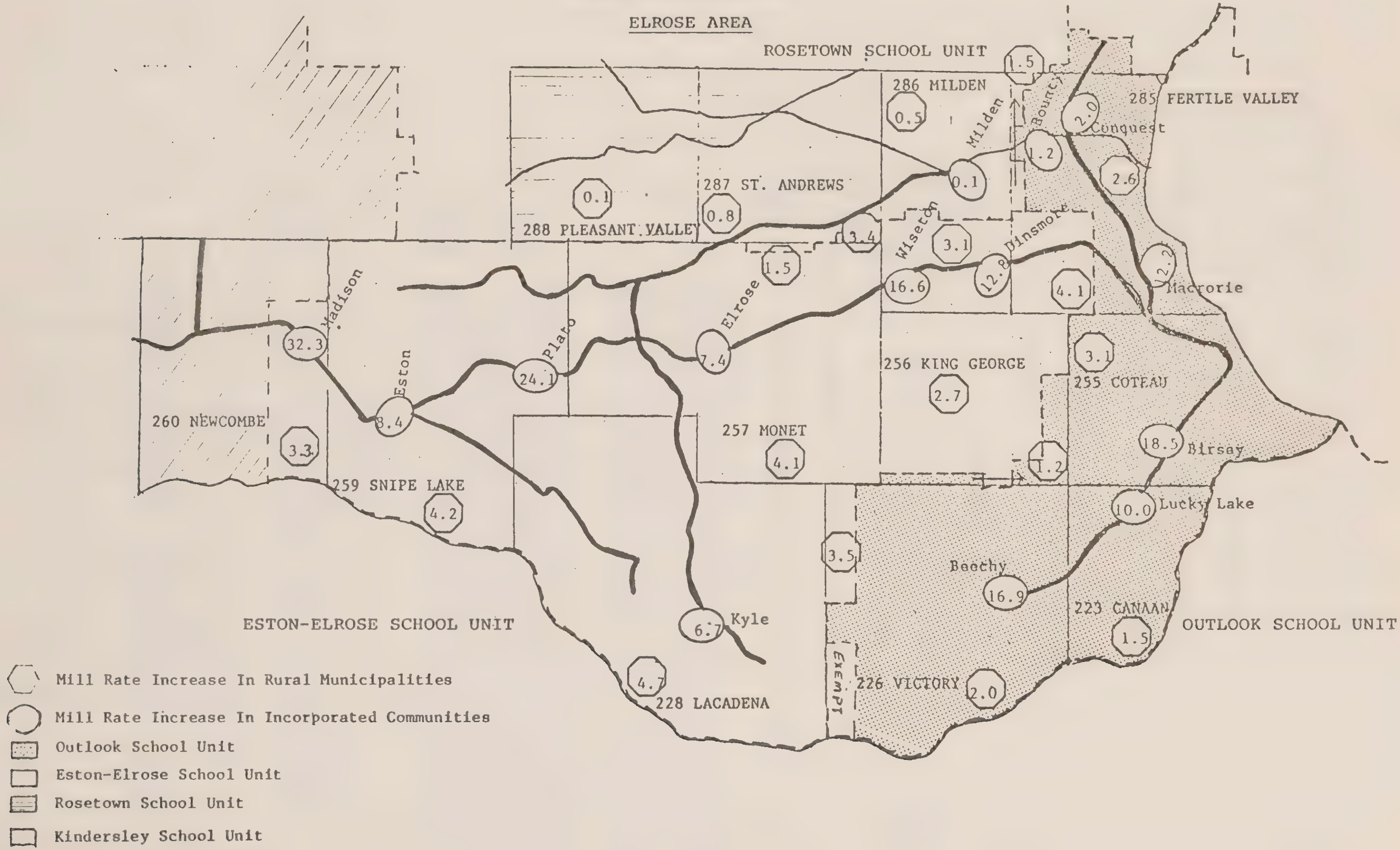
	ESTON - ELROSE SCHOOL UNIT			OUTLOOK SCHOOL UNIT			ROSETOWN SCHOOL UNIT		
	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %
INCORPORATED COMMUNITIES									
CONQUEST									
school	-	-	-	39.0	40.2	3.1	-	-	-
municipal	-	-	-	34.2	35.0	2.3	-	-	-
TOTAL	-	-	-	73.2	75.2	2.7	-	-	-
DINSMORE									
school	46.0	48.7	5.9	-	-	-	-	-	-
municipal	38.0	48.1	26.6	-	-	-	-	-	-
TOTAL	84.0	96.8	15.2	-	-	-	-	-	-
LUCKY LAKE									
school	-	-	-	39.0	40.2	3.1	-	-	-
municipal	-	-	-	43.0	51.8	20.4	-	-	-
TOTAL	-	-	-	82.0	92.0	12.2	-	-	-
MACRORIE									
school	-	-	-	39.0	40.2	3.1	-	-	-
municipal	-	-	-	30.0	41.0	36.7	-	-	-
TOTAL	-	-	-	69.0	81.2	17.7	-	-	-
MADISON									
school	46.0	48.7	5.9	-	-	-	-	-	-
municipal	28.0	57.6	105.7	-	-	-	-	-	-
TOTAL	74.0	106.3	43.6	-	-	-	-	-	-
MILDEN									
school	-	-	-	-	-	-	45.0	45.1	0.2
municipal	-	-	-	-	-	-	32.0	32.0	0.0
TOTAL	-	-	-	-	-	-	77.0	77.1	0.1

PRESENT AND PROJECTED MILL RATES OF MUNICIPALITIES AND INCORPORATED COMMUNITIES BY SCHOOL UNITS, BASIS 1975.

	ESTON - ELROSE SCHOOL UNIT			OUTLOOK SCHOOL UNIT			ROSETOWN SCHOOL UNIT		
	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE
INCORPORATED COMMUNITIES			%			%			%
PLATO									
school	46.0	48.7	5.9	-	-	-	-	-	-
municipal	30.0	51.4	71.3	-	-	-	-	-	-
TOTAL	76.0	100.1	31.7	-	-	-	-	-	-
WISETON									
school	46.0	46.8	5.9	-	-	-	-	-	-
municipal	42.0	57.8	37.6	-	-	-	-	-	-
TOTAL	88.0	104.6	18.9	-	-	-	-	-	-

FIGURE IV-1 ALTERNATIVE 1

ELROSE AREA



3) R.M. of Fertile Valley, No. 285. The municipality of Fertile Valley is in three school units. The mill rates for those taxpayers in:

   a) the Rosetown school unit increased by 1.5 mills;

   b) the Outlook school unit increased by 2.6 mills;

   c) the Eston-Elrose school unit increased by 4.1 mills.

4) Madison. The village of Madison's school mill rate increased by 5.9 percent while the municipal rate increased by 105.7 percent. Had the burden of loss of assessment not been distributed amongst other taxpayers in the school unit, the projected mill rate would have been much higher (approximately 152.2 mills) than the 106.3 mills suggested here.

5) R.M. of Pleasant Valley, No. 288. The municipality of Pleasant Valley is representative of those municipalities (outside the study area) where the municipal mill rate is unaffected but the school mill rate increases (0.1 mills).

Table IV-4 shows a comparison of right-of-way tax levy lost by municipalities and communities and the increase in tax levy on the remaining assessment. The right-of-way tax levy lost is calculated by multiplying the loss of assessment by the present mill rate, while the increase in tax levy on the remaining assessment is calculated by multiplying the projected total assessment by the projected increase in mill rate. This table illustrates the distributional effects once more as it shows that any one group of taxpayers can either pay more or less than the actual tax levy lost in their tax zone. For example, in the municipality of Lacadena, the right-of-way levy lost is $30,713 and the increase in tax levy on the remaining assessment is $33,016. These taxpayers must not only make up the loss of tax levy in their own

TABLE IV-4

A COMPARISON OF RIGHT-OF-WAY TAX LEVY LOST AND THE INCREASE IN TAX LEVY ON REMAINING ASSESSMENT, BASIS 1975

	ESTON-ELROSE SCHOOL UNIT		OUTLOOK SCHOOL UNIT		ROSETOWN SCHOOL UNIT	
ALTERNATIVE 1	RIGHT-OF-WAY TAX LEVY LOST	INCREASE IN TAX LEVY ON REMAINING ASSESSMENT	RIGHT-OF-WAY TAX LEVY LOST	INCREASE IN TAX LEVY ON REMAINING ASSESSMENT	RIGHT-OF-WAY TAX LEVY LOST	INCREASE IN TAX LEVY ON REMAINING ASSESSMENT
MUNICIPALITIES			$			
225 Canaan	-	-	828	2,479	-	-
226 Victory	-	706	4,341	4,945	-	-
228 Lacadena	30,713	33,016	-	-	-	-
255 Coteau	-	-	6,975	5,952	-	-
256 King George	-	4,269	-	324	-	-
257 Monet	21,540	24,996	-	-	-	173
259 Snipe Lake	27,094	36,707	-	-	-	-
260 Newcombe	501	3,299	-	-	-	-
285 Fertile Valley	937	2,862	9,253	7,113	-	474
286 Milden	2,530	3,970	-	-	1,342	1,484
287 St. Andrews	-	457	-	-	6,979	3,769
288 Pleasant Valley	-	-	-	-	-	241
INCORPORATED COMMUNITIES						
Elrose	10,307	7,106	-	-	-	-
Eston	25,353	19,192	-	-	-	-
Kyle	7,845	5,985	-	-	-	-
Beechy	-	-	13,751	8,091	-	-
Birsay	-	-	4,020	2,258	-	-
Bounty	-	-	-	104	-	-
Conquest	-	-	603	706	-	-
Dinsmore	14,595	8,355	-	-	-	-
Lucky Lake	-	-	8,258	4,935	-	-
Macrorie	-	-	3,222	1,552	-	-
Madison	5,901	2,437	-	-	-	-
Milden	-	-	-	-	-	47
Plato	3,844	1,704	-	-	-	-
Wiseton	7,452	3,742	-	-	-	-

tax zone but are also responsible for $697 ($33,713 - $33,016) of increased tax levies attributable to lost assessment in other tax zones. This is due to the averaging effect of mill rates which apply equally to all zones within a jurisdiction.

Alternative II

For purposes of Alternative II, it was assumed that the McMorran and Matador subdivisions are closed and an eight-mile link is constructed between White Bear and Kyle. The largest projected loss of assessment and tax levy would once again occur in the R.M. of Lacadena. This loss is $145,260 and represents 2.0 percent of the total assessment and a loss of $12,565 of tax levy. None of the incorporated communities would experience any loss of assessment under this alternative. It should be noted that the additional eight miles of rail line constructed was assumed to be assessed at $800 per mile ($6,400) and was included in the figure "loss of taxable assessment" in Table IV-5 ($151,660 - $6,400 = $145,260).

Figure IV-2 shows the increase in mill rate for each tax zone in the study area under Alternative II. The largest increase in total mill rate in a rural municipality was in Lacadena which increased 1.2 miles or 1.4 percent.

Other distributional effects of Alternative II are as follows:

1) There was no change in the school mill rate or municipal mill rate for any tax zone in the Outlook School District.

2) While there were no changes in the municipal mill rates in the incorporated communities, those communities

TABLE IV-5 : LOSS OF TAXABLE ASSESSMENT BY TAXING AUTHORITY AND PROJECTED SCHOOL AND MUNICIPAL MILL RATES

ALTERNATIVE 2	TOTAL TAX ASSESSMENT	ESTON-ELROSE SCHOOL UNIT TAXABLE ASSESSMENT	ESTON-ELROSE SCHOOL UNIT LOSS OF TAXABLE ASSESSMENT	ESTON-ELROSE SCHOOL UNIT PROJECTED TAXABLE ASSESSMENT	OUTLOOK SCHOOL UNIT TAXABLE ASSESSMENT	OUTLOOK SCHOOL UNIT LOSS OF TAXABLE ASSESSMENT	OUTLOOK SCHOOL UNIT PROJECTED TAXABLE ASSESSMENT	ROSETOWN SCHOOL UNIT TAXABLE ASSESSMENT	ROSETOWN SCHOOL UNIT LOSS OF TAXABLE ASSESSMENT	ROSETOWN SCHOOL UNIT PROJECTED TAXABLE ASSESSMENT	PROJECTED TOTAL TAX ASSESSMENT	PRESENT MUNICIPAL MILL RATE	PROJECTED MUNICIPAL MILL RATE
MUNICIPALITIES													
225 Canaan	1,661,510	-	-	-	1,661,510	-	1,661,510	-	-	-	1,661,510	52.5	52.5
226 Victory	2,965,670	201,720	-	201,720	2,524,450	-	2,524,450	-	-	-	2,965,670	44.2	44.2
228 Lacadena	7,379,780	7,379,780	145,260	7,234,520	-	-	-	-	-	-	7,234,520	40.5	41.3
255 Coteau	2,003,000	-	-	-	2,003,000	-	2,003,000	-	-	-	2,003,000	45.0	45.0
256 King George	1,851,290	1,581,020	-	1,581,020	270,270	-	270,270	-	-	-	1,851,020	40.0	40.0
257 Monet	6,488,660	6,373,110	64,160	6,308,950	-	-	-	115,550	-	115,550	6,424,500	31.9	32.2
259 Snipe Lake	9,051,080	9,051,080	68,610	8,982,470	-	-	-	-	-	-	8,982,470	41.0	41.4
260 Newcombe	3,810,640	1,005,434	-	1,005,434	-	-	-	-	-	-	3,810,640	43.5	43.5
285 Fertile Valley	3,766,164	709,326	-	709,326	2,735,594	-	2,735,594	316,094		316,094	3,766,164	37.2	37.2
286 Milden	4,293,760	1,310,130	-	1,310,130	-	-	-	2,983,630	15,880	2,967,750	4,277,880	39.5	39.6
287 St. Andrews	4,929,450	134,360	-	134,360	-	-	-	4,795,090	84,090	4,711,000	4,845,360	38.0	38.7
288 Pleasant Valley	-	-	-	-	-	-	-	2,413,835	-	2,413,835	N.A.	N.A.	N.A.
Other R.M's	-	-	-	-	5,938,261	-	5,938,261	14,547,350	-	14,547,350	-	-	-
Sub-total	-	27,745,960	278,030	27,467,930	15,133,085	-	15,133,085	25,171,549	99,970	25,071,579	-	-	-
INCORPORATED COMMUNITIES													
Elrose	1,085,940	1,085,940	-	1,085,940	-	-	-	-	-	-	1,085,940	36.0	36.0
Eston	2,551,670	2,551,670	-	2,551,670	-	-	-	-	-	-	2,551,670	49.0	49.0
Kyle	985,530	985,530	-	985,530	-	-	-	-	-	-	985,530	39.0	39.0
Beechy	638,660	-	-	-	638,660	-	638,660	-	-	-	638,660	47.0	47.0
Birsay	171,110	-	-	-	171,110	-	171,110	-	-	-	171,110	43.0	43.0
Bounty	86,780	-	-	-	86,780	-	86,780	-	-	-	86,780	30.0	30.0
Conquest	361,040	-	-	-	361,040	-	361,040	-	-	-	361,040	34.2	34.2
Dinsmore	826,510	826,510	-	826,510	-	-	-	-	-	-	826,510	38.0	38.0
Lucky Lake	594,180	-	-	-	594,180	-	594,180	-	-	-	594,180	43.0	43.0
Macrorie	173,930	-	-	-	173,930	-	173,930	-	-	-	173,930	30.0	30.0
Madison	155,190	155,190	-	155,190	-	-	-	-	-	-	155,190	28.0	28.0
Milden	469,880	-	-	-	-	-	-	469,880	-	469,880	469,880	32.0	32.0
Plato	121,290	121,290	-	121,290	-	-	-	-	-	-	121,290	30.0	30.0
Kiseton	310,095	84,680	-	84,680	-	-	-	-	-	-	310,095	42.0	42.0
Others	-	-	-	-	4,442,400	-	4,442,400	7,845,280	-	7,845,280	-	-	-
Sub-Total	-	6,036,225	-	6,036,225	6,468,100	-	6,468,100	8,315,160	-	8,315,160	-	-	-
TOTAL	-	33,782,185	278,030	33,507,155	21,601,185		21,601,185	33,486,709	99,970	33,386,739	-	-	-
Present School Mill Rate		46.0			39.0		45.0						
Projected School Mill Rate		46.4			39.0		45.1						

FIGURE IV-2 ALTERNATIVE II

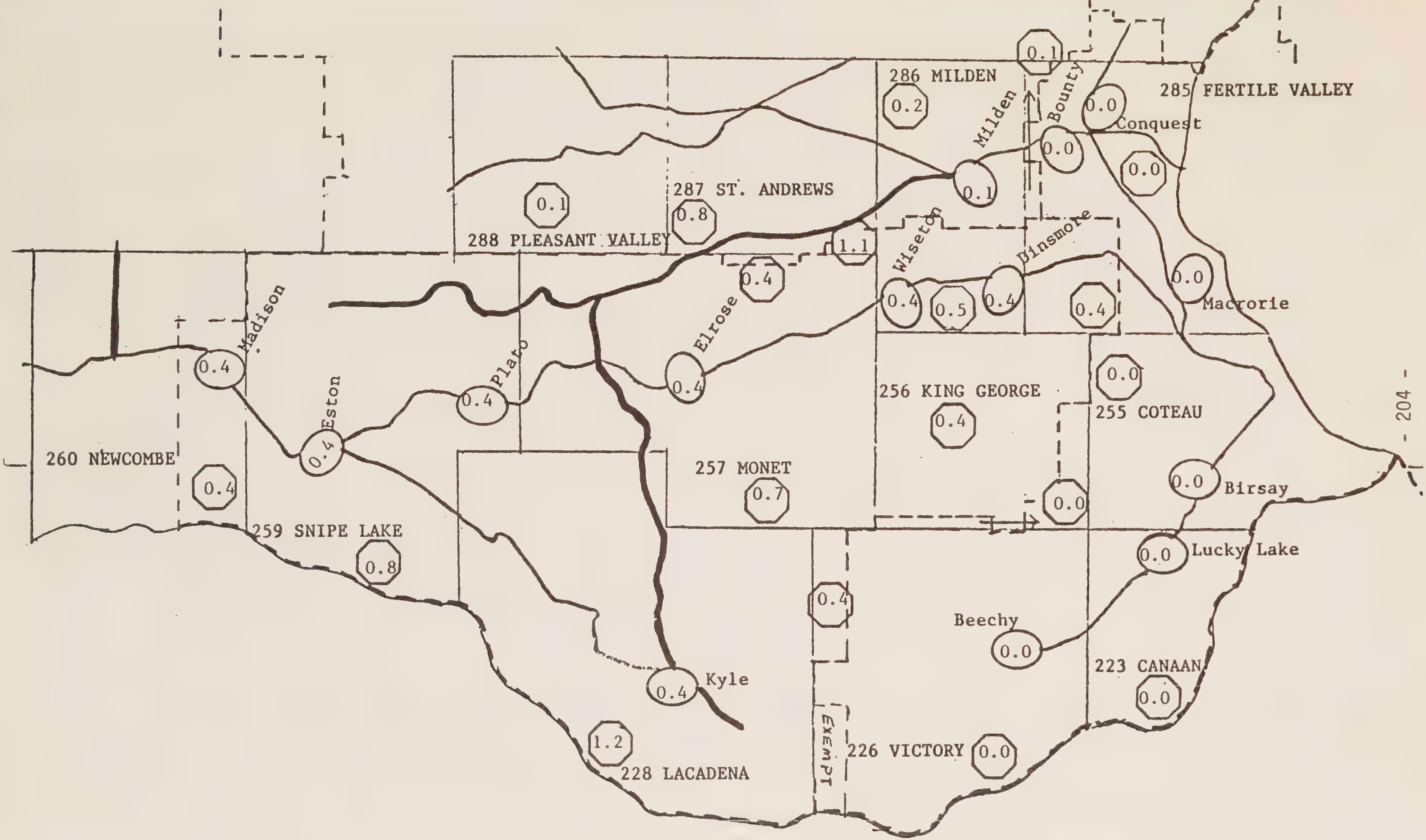


TABLE IV-6

PRESENT AND PROJECTED MILL RATES OF MUNICIPALITES AND INCORPORATED COMMUNITIES BY SCHOOL UNITS, BASIS 1975.

	ESTON - ELROSE SCHOOL UNIT			OUTLOOK SCHOOL UNIT			ROSETOWN SCHOOL UNIT		
ALTERNATIVE 2	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE
			%			%			%
MUNICIPALITIES									
225 CANAAN									
school	-	-	-	39.0	39.0	0.0	-	-	-
municipal	-	-	-	52.5	52.5	0.0	-	-	-
TOTAL	-	-	-	91.5	91.5	0.0	-	-	-
226 VICTORY									
school	46.0	46.4	0.9	39.0	39.0	0.0	-	-	-
municipal	44.2	44.2	0.0	44.2	44.2	0.0	-	-	-
TOTAL	90.2	90.6	0.4	83.2	83.2	0.0	-	-	-
228 LACADENA									
school	46.0	46.4	0.9	-	-	-	-	-	-
municipal	40.5	41.3	2.0	-	-	-	-	-	-
TOTAL	86.5	87.7	1.4	-	-	-	-	-	-
255 COTEAU									
school	-	-	-	39.0	39.0	0.0	-	-	-
municipal	-	-	-	45.0	45.0	0.0	-	-	-
TOTAL	-	-	-	84.0	84.0	0.0	-	-	-
256 KING GEORGE									
school	46.0	46.4	0.9	39.0	39.0	0.0	-	-	-
municipal	40.0	40.0	0.0	40.0	40.0	0.0	-	-	-
TOTAL	86.0	86.4	0.5	79.0	79.0	0.0	-	-	-
257 MONET									
school	46.0	46.4	0.9	-	-	-	45.0	45.1	0.2
municipal	31.9	32.2	0.9	-	-	-	31.9	32.2	0.9
TOTAL	77.9	78.6	0.9	-	-	-	76.9	77.3	0.5

TABLE IV-6 cont'd

PRESENT AND PROJECTED MILL RATES OF MUNICIPALITIES AND INCORPORATED COMMUNITIES BY SCHOOL UNITS, BASIS 1975.

	ESTON - ELROSE SCHOOL UNIT			OUTLOOK SCHOOL UNIT			ROSETOWN SCHOOL UNIT		
ALTERNATIVE 2	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %
MUNICIPALITIES									
259 SNIPE LAKE									
school	46.0	46.4	0.9	-	-	-	-	-	-
municipal	41.0	41.4	1.0	-	-	-	-	-	-
TOTAL	87.0	87.8	0.9	-	-	-	-	-	-
260 NEWCOMBE									
school	46.0	46.4	0.9	-	-	-	-	-	-
municipal	43.5	43.5	0.0	-	-	-	-	-	-
TOTAL	89.5	89.9	0.4	-	-	-	-	-	-
285 FERTILE VALLEY									
school	46.0	46.4	0.9	39.0	39.0	0.0	45.0	45.1	0.2
municipal	37.2	37.2	0.0	37.2	37.2	0.0	37.2	37.2	0.0
TOTAL	83.2	83.6	0.5	76.2	76.2	0.0	82.2	82.3	0.1
286 MILDEN									
school	46.0	46.4	0.9	-	-	-	45.0	45.1	0.2
municipal	39.5	39.6	0.3	-	-	-	39.5	39.6	0.3
TOTAL	85.5	86.0	0.6	-	-	-	84.5	84.7	0.2
287 ST. ANDREWS									
school	46.0	46.4	0.9	-	-	-	45.0	45.1	0.2
municipal	38.0	38.7	1.8	-	-	-	38.0	38.7	1.8
TOTAL	84.0	85.1	1.3	-	-	-	83.0	83.8	1.0
288 PLEASANT VALLEY[1]									
school	-	-	-	-	-	-	45.0	45.1	0.2
municipal	-	-	-	-	-	-	-	-	0.0
TOTAL	-	-	-	-	-	-	45.0	45.1	0.2

1 The municipality of Pleasant Valley is representative of those municipalities within the Rosetown School Unit whre the municipal mill rate is unaffected.

TABLE IV-6 (cont'd)

PRESENT AND PROJECTED MILL RATES OF MUNICIPALITIES AND INCORPORATED COMMUNITIES BY SCHOOL UNITS, BASIS 1975.

	ESTON - ELROSE SCHOOL UNIT			OUTLOOK SCHOOL UNIT			ROSETOWN SCHOOL UNIT		
ALTERNATIVE 2	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %
INCORPORATED COMMUNITIES									
ELROSE									
school	46.0	46.4	0.9	-	-	-	-	-	-
municipal	36.0	36.0	0.0	-	-	-	-	-	-
TOTAL	82.0	82.4	0.5	-	-	-	-	-	-
ESTON									
school	46.0	46.4	0.9	-	-	-	-	-	-
municipal	49.0	49.0	0.0	-	-	-	-	-	-
TOTAL	95.0	95.4	0.4	-	-	-	-	-	-
KYLE									
school	46.0	46.4	0.9	-	-	-	-	-	-
municipal	39.0	39.0	0.0	-	-	-	-	-	-
TOTAL	85.0	85.4	0.5	-	-	-	-	-	-
BEECHY									
school	-	-	-	39.0	39.0	0.0	-	-	-
municipal	-	-	-	47.0	47.0	0.0	-	-	-
TOTAL	-	-	-	86.0	86.0	0.0	-	-	-
BIRSAY									
school	-	-	-	39.0	39.0	0.0	-	-	-
municipal	-	-	-	43.0	43.0	0.0	-	-	-
TOTAL	-	-	-	82.0	82.0	0.0	-	-	-
BOUNTY									
school	-	-	-	39.0	39.0	0.0	-	-	-
municipal	-	-	-	30.0	30.0	0.0	-	-	-
TOTAL	-	-	-	69.0	69.0	0.0	-	-	-

TABLE IV-6 (cont'd)

PRESENT AND PROJECTED MILL RATES OF MUNICIPALITIES AND INCORPORATED COMMUNITIES BY SCHOOL UNITS, BASIS 1975.

ALTERNATIVE 2	ESTON - ELROSE SCHOOL UNIT			OUTLOOK SCHOOL UNIT			ROSETOWN SCHOOL UNIT		
	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE %
INCORPORATED COMMUNITIES									
CONQUEST									
school	-	-	-	39.0	39.0	0.0	-	-	-
municipal	-	-	-	34.2	34.2	0.0	-	-	-
TOTAL	-	-	-	73.2	73.2	0.0	-	-	-
DINSMORE									
school	46.0	46.4	0.9	-	-	-	-	-	-
municipal	38.0	38.0	0.0	-	-	-	-	-	-
TOTAL	84.0	84.4	0.5	-	-	-	-	-	-
LUCKY LAKE									
school	-	-	-	39.0	39.0	0.0	-	-	-
municipal	-	-	-	43.0	43.0	0.0	-	-	-
TOTAL	-	-	-	82.0	82.0	0.0	-	-	-
MACRORIE									
school	-	-	-	39.0	39.0	0.0	-	-	-
municipal	-	-	-	30.0	30.0	0.0	-	-	-
TOTAL	-	-	-	69.0	69.0	0.0	-	-	-
MADISON									
school	46.0	46.4	0.9	-	-	-	-	-	-
municipal	28.0	28.0	0.0	-	-	-	-	-	-
TOTAL	74.0	74.4	0.5	-	-	-	-	-	-
MILDEN									
school	-	-	-	-	-	-	45.0	45.1	0.2
municipal	-	-	-	-	-	-	32.0	32.0	0.0
TOTAL	-	-	-	-	-	-	77.0	77.1	0.1

TABLE IV-6 (cont'd)

PRESENT AND PROJECTED MILL RATES OF MUNICIPALITIES AND INCORPORATED COMMUNITIES BY SCHOOL UNITS, BASIS 1975.

ALTERNATIVE 2	ESTON - ELROSE SCHOOL UNIT			OUTLOOK SCHOOL UNIT			ROSETOWN SCHOOL UNIT		
	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE	PRESENT MILL RATE	NEW MILL RATE	PERCENTAGE CHANGE
			%			%			%
INCORPORATED COMMUNITIES									
PLATO									
school	46.0	46.4	0.9	-	-	-	-	-	-
municipal	30.0	30.0	0.0	-	-	-	-	-	-
TOTAL	76.0	76.4	0.5	-	-	-	-	-	-
WISETON									
school	46.0	46.4	0.9	-	-	-	-	-	-
municipal	42.0	42.0	0.0	-	-	-	-	-	-
TOTAL	88.0	88.4	0.5	-	-	-	-	-	-

in the Eston-Elrose School District would experience an increase of 0.4 mills due to the increase in the school portion of the total mill rate.

3) Milden. The village of Milden is on a protected line and does not have an increase in municipal mill rate yet its total projected mill rate would increase by 0.1 mills as a result of the change in school mill rate in the Rosetown School District.

Table IV-7 shows the right-of-way tax levy lost and the increase in tax levy on remaining assessment for municipalities and communities under Alternative II. As stated before, none of the incorporated communities experienced a loss of assessment, however, those communities in the Eston-Elrose and Rosetown School Districts will have an increase in the tax levy due to the increase of the school mill rates. These communities will now contribute a larger proportion of the total school tax levy to the school district than before abandonment.

TABLE IV-7

A COMPARISON OF RIGHT-OF-WAY TAX LEVY LOST AND THE INCREASE IN TAX LEVY ON REMAINING ASSESSMENT, BASIS 1975

	ESTON-ELROSE SCHOOL UNIT		OUTLOOK SCHOOL UNIT		ROSETOWN SCHOOL UNIT	
ALTERNATIVE II	RIGHT-OF-WAY TAX LEVY LOST	INCREASE IN TAX LEVY ON REMAINING ASSESSMENT	RIGHT-OF-WAY TAX LEVY LOST	INCREASE IN TAX LEVY ON REMAINING ASSESSMENT	RIGHT-OF-WAY TAX LEVY LOST	INCREASE IN TAX LEVY ON REMAINING ASSESSMENT
MUNICIPALITIES	$	$	$	$	$	$
225 Canaan	-	-	-	-	-	-
226 Victory	-	81	-	-	-	-
228 Lacadena	12,565	8,681	-	-	-	-
255 Coteau	-	-	-	-	-	-
256 King George	-	632	-	-	-	-
257 Monet	4,998	4,416	-	-	-	46
259 Snipe Lake	5,969	7,186	-	-	-	-
260 Newcombe	-	402	-	-	-	-
285 Fertile Valley	-	284	-	-	-	32
286 Milden	-	655	-	-	1,358	594
287 St. Andrews	-	148	-	-	7,063	3,769
288 Pleasant Valley	-	-	-	-	-	241
INCORPORATED COMMUNITIES						
Elrose	-	434	-	-	-	-
Eston	-	1,021	-	-	-	-
Kyle	-	394	-	-	-	-
Beechy	-	-	-	-	-	-
Birsay	-	-	-	-	-	-
Bounty	-	-	-	-	-	-
Conquest	-	-	-	-	-	-
Dinsmore	-	331	-	-	-	-
Lucky Lake	-	-	-	-	-	-
Macrorie	-	-	-	-	-	-
Madison	-	62	-	-	-	-
Milden	-	-	-	-	-	47
Plato	-	49	-	-	-	-
Wiscton	-	34	-	-	-	-

A P P E N D I X

APPENDIX

Additional Effects

One of the effects of rail service discontinuance is to increase the average haul of producer in the delivery of grains. Since the assessment of arable land for tax purposes recognizes the distance to market as a determinant of land productivity, it is important that this element be included in the measurement of impact of rail service discontinuance.

This element has two effects of interest. First, the decreased assessment of arable land results in a lower rate of taxation (cost of production) to producers. Second, the decreased assessment reduces the tax base of rural municipalities and school district. From a system's view these effects cancel each other in total but have a distributional effect between the elements of the system.

From the producer's point of view, the reduced taxes partially offset the increased transportation costs involved in delivering grain increased distances. If this approach is taken, then it is valid to attribute a cost of rail service discontinuance to rural municipalities equal to lost tax revenues.

The purpose of this appendix is to explore:

1) the magnitude of tax savings by producers as compared to increased trucking costs, and

2) the magnitude of revenues lost by rural municipalities.

Impact on Producers

The increase in trucking costs experienced by producers is equal to the increase in bushel-miles required to deliver grain involved in the abandonment of a branch line multiplied by the cost of transporting grain in cents per bushel-mile. The related decrease in tax, on the other hand, is determined by multiplying the original assessment by discount factor times the current mill rate. Since the discount factor varies with the miles to market and the land assessment varies with the yield of arable land, it is likely that the increase in trucking costs and the decrease in taxes are closely related. The following hypothetical example will serve to demonstrate the relationship discussed above.

Assumptions

R.M. with 210 thousand acres
200 thousand acres arable

Land Assessment	=	$4,700,000
Total Assessment	=	$5,000,000
Trucking costs	=	5 cents per bushel-mile
Average yield	=	15 bushels per acre
Total production	=	3,000,000 bushels
Current mill rate	=	80 mills
Original average trucking distance	=	5 miles

Adjustments for accessibility to markets (See Table IV-A.1)

TABLE IV-A.1

TABLE OF DISCOUNTS TO MARKET

Discounts for Accessibility to Market					
Miles	Adjusted Percent	Miles	Adjusted Percent	Miles	Adjusted Percent
1	0	21	11	41	14
2	1	22	11	42	14
3	2	23	11	43	15
4	3	24	12	44	15
5	4	25	12	45	15
6	5	26	12	46	15
7	6	27	12	47	15
8	6	28	12	48	15
9	7	29	13	49	15
10	7	30	13	50	15
11	8	31	13	51	15
12	8	32	13	52	15
13	9	33	13	53	16
14	9	34	13	54	16
15	9	35	14	55	16
16	10	36	14	56	16
17	10	37	14	57	16
18	10	38	14	58	16
19	11	39	14	59	16
20	11	40	14	60	16

The additional trucking costs and reduced taxes for the total Rural Municipality are as follows:

TABLE IV-A.2

RELATIONSHIP BETWEEN INCREASED TRUCKING COSTS AND DECREASED LAND TAXES

Additional Miles	Additional Bushel-Miles (000,000's)	Additional Trucking Costs ($)	Discount Factor (%)	Reduced Taxes	Taxes as % of Trucking Cost
1	3	15,000	1	3,760	25.07
5	15	75,000	3	11,280	15.04
10	30	150,000	5	18,800	12.53
15	45	225,000	7	26,320	11.70
20	60	300,000	8	30,080	10.27
25	75	375,000	9	33,840	9.02

The above table shows that the reduced taxes significantly reduce the impact of trucking costs. In addition it indicates that the reduction in taxes is a more important element in smaller increases in trucking distances. The exact relationship between additional trucking costs and reduced property taxes will vary between rural municipalities but it is likely in the range of one-fifth to one-third of additional trucking costs for moderate increases in distance.

Impact on Rural Municipalities and School Districts

The direct effect of rail line abandonment on rural municipalities and school districts will be to lose the taxes paid by the railways and rail dependent facilities such as elevators. Indirectly, these tax authorities lose taxes because of downward adjusted assessment. Table IV-A.3 suggests the magnitude of these losses.

TABLE IV-A.3

EFFECT ON R.M. REVENUE OF TRUCKING DISTANCE ADJUSTMENT OF ASSESSMENT

Additional Miles	Original Assessment	Loss of Assessment (Distance adj.)	Percentage Loss (%)	Lost Revenue ($)
1	5,000,000	47,000	.94	3,760
5	5,000,000	141,000	2.8	11,280
10	5,000,000	235,000	4.7	18,800
15	5,000,000	329,000	6.6	26,320
20	5,000,000	376,000	7.5	30,080
25	5,000,000	423,000	8.5	33,840

The above table indicates that the downward adjustment of land assessment has a significant effect on rural municipality and school district revenues when increased trucking distances are moderate to high. The size of this lost revenue is probably greater than the direct loss from railways and rail related taxpayers.

CHAPTER 5

MINI-TRAIN OPERATION WITH TRANSLOADING FACILITIES -- A FEASIBILITY STUDY

P.M.L.P. Consultants Ltd.

EXECUTIVE SUMMARY

Study Objectives:

1. This Chapter summarizes a study of four grain handling and transportation alternatives for application on light density branch lines.

2. Each of the alternatives was structured to utilize the existing elevator system on the branch lines. The four alternatives examined were:

   - a mini train alternative: an independently owned/operated power unit delivering modified grain cars from the elevator to a transloading facility on the main line where the grain would be transferred to a hopper car.

   - a short line alternative: an independently owned/operated power unit delivering grain cars from the elevator to the mainline for train assembly.

   - a trucking alternative: an independently owned/operated trucking fleet would delivery grain from the elevators to a transloading facility on the mainline. The grain would be transferred to a hopper car.

   - the do nothing alternative: continuation of the current system.

Study Methodology

1. Each of the four grain handling and transportation alternatives was examined for its technical feasibility.

2. Grain handling and labour implications for each of the four alternatives were also defined.

3. The operational economics of the four alternatives as applied to three typical branch line areas were defined.

4. Sensitivity analyses to show the variation in operational economics for changes in the underlying parameters are summarized in the report. Sensitivity analyses were conducted on the following parameters:

   - grain volumes
   - rail right of way acquisition costs and alternative rail maintenance options.

5. The comparative operational economics across the three areas was also examined. From this analysis it was possible to derive conclusions as to alternative applications.

Conclusions

1. Summary Table V-1 is a display of the four grain handling and transportation alternatives. The following can be concluded:

   - all power units for the four alternatives possess the technical capability for operation.
   - the most expensive power unit is the truck tractor with an annual cost of $19 thousand.
   - the short line and do nothing alternatives use the same grain cars as at present. Demurrage charges for the short line may run to $16 per grain car. Capital outlay for the modified grain cars is estimated at $7,433 per car and for the trucking at $12 thousand per trailer.
   - transloading facilities are required for the mini-train and trucking alternatives. Capital outlays are $210 thousand and $67 thousand respectively. This translates to an annual cost of $65.9 thousand (mini-train) and $42.2 thousand (trucking). Both facilities have adequate capacity.

2. Some grain handling restrictions are anticipated with the mini-train and trucking concepts. Each of these alternatives must load multiple cars (trailers) of grain equal to the capacity of a covered hopper car. Although the restrictions are not insurmountable, additional handling costs are incurred.

3. The labour implications of implementing the alternatives were not deemed as insurmountable. It was felt that if a small number of branch lines changed to any of the alternatives few labour problems would be experienced.

4. The operational economics of the branch line alternatives are shown in Summary Figure V-1. A number of conclusions can be derived as to possible applications and these are:

   - Trucking from elevator points to transloading facilities is the least costly up to a transport product of about 2.5 million ton-miles per annum. This represents branch lines from 30 to 120 miles in length handling between 3.0 and 0.8 million bushels respectively.

   - However, the cross hatched lines on the trucking and short line curves are indicative of the wide variation that may exist because of varying rail acquisition and rail maintenance values.

   - As the rail acquisition and rail maintenance costs increase, the range over which trucking is a viable alternative also increases.

   - In other words, if the existing trackage is in poor condition, then in all likelihood trucking is the least costly alternative.

   - On the other hand, if grain volumes are moderate to high in an area, the short line concept is applicable if the trackage is in reasonable condition. (Large cpaital outlays to maintain the track are not required).

SUMMARY TABLE V-1

GRAIN HANDLING AND TRANSPORT ALTERNATIVES

- COMPARISON -

Component	Mini-Train	Short Line	Trucking	Do Nothing
Power Unit	Diesel Electric	Diesel Electric	Truck Tractor	Diesel Electric
Technical Capability	good	good	good	good
Capital Outlay	$80,000	$80,000	$37,500	as current
Annual Capital	10,518	10,518	18,720	as current
Operating Cost/Hour*	$5.45	$5.45	$10.36**	as current
Grain Cars				
Technical Capability	good	as current	hoppered trailer	as current
Capital Outlay	$7,433 per car	n.a.	$12,000 per trailer	as current
Annual Capital	$977	$16 per car***	$2,416	as current
Maintenance Costs	$200 per annum	as current	$890 per annum ****	as current
Transloading Facility				
Technical Capability	good	n.a.	good	n.a.
Capital Outlay	$210,067	n.a.	$66,575	n.a.
Annual Capital	$ 65,902	n.a.	$42,216	n.a.
Capacity	7.5 mm bu./year	n.a.	10.0 mm bu./year	n.a.
Elevator				
Total Capital	n.a.	n.a.	$5,000	n.a.
Annual Capital	n.a.	n.a.	$660	n.a.
Maintenance Costs	n.a.	n.a.	$200	n.a.
Grain Handling	some problems	as current	some problems	as current

* Excludes wages

** Based on 40 miles driving per hour

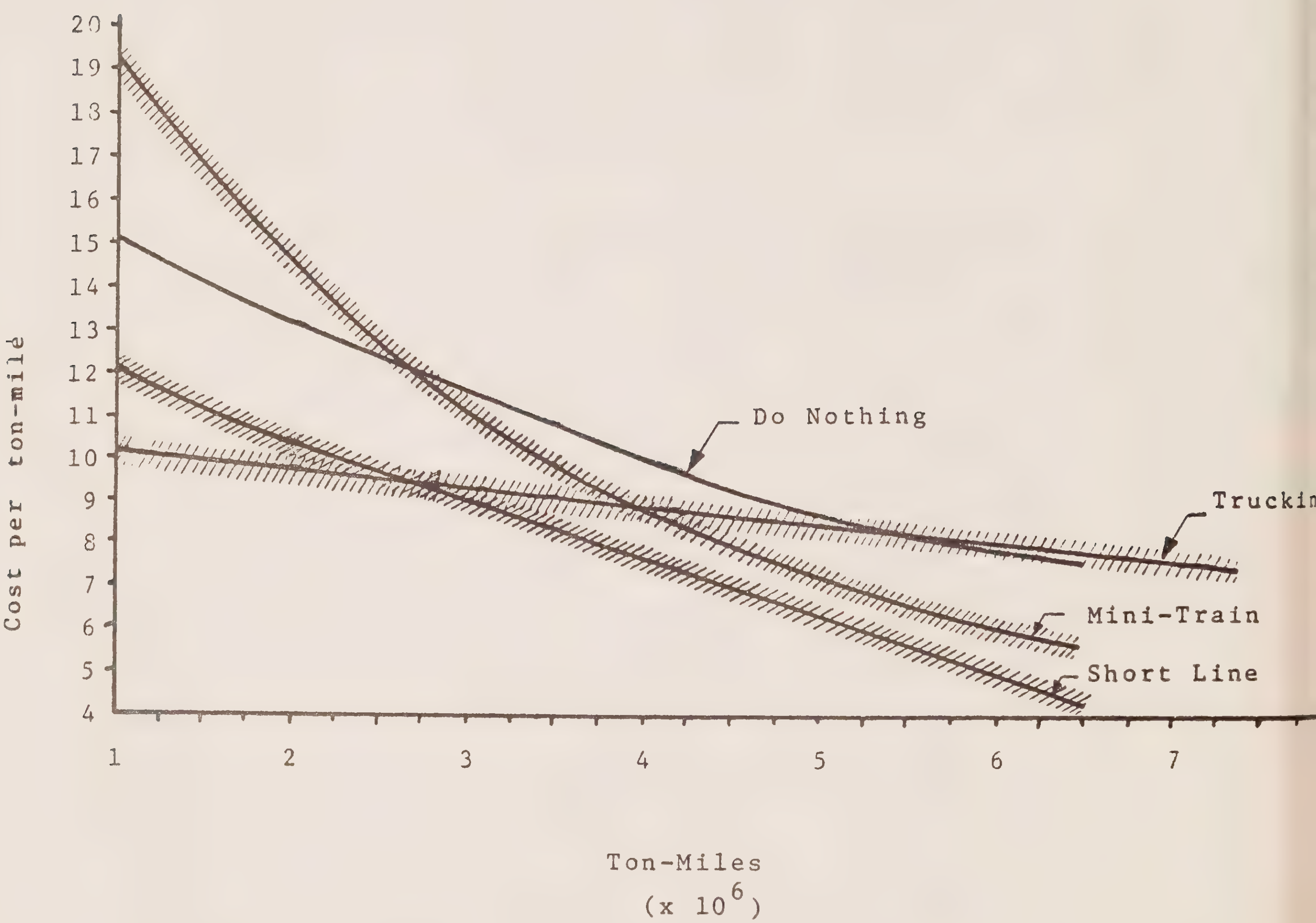
*** Two days demurrage per car

**** Based on 35,000 miles per annum

SUMMARY FIGURE V-1

OPERATIONAL ECONOMICS OF BRANCH LINE ALTERNATIVE

(cost per ton-mile versus transport production)



- In all applications the short line concept will reduce the annual subsidy requirements.

- The need for transloading facilities and grain car conversion negates the desirability of the mini-train concept. In other words the mini-train cannot compete with the short line because of the additional costs associated with the transloading facility. The advantage of loading to hopper cars does not make up for this additional cost.*

- The least desirable concept in economic terms is the continuation of the current system.

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* This assumes that the advantages of hopper car operations on the main line do not fully compensate for the costs of the transloading facility and the additional handling involved.

A Feasibility Study

MINI-TRAIN OPERATION WITH TRANSLOADING FACILITIES

INTRODUCTION

The agricultural economy of Western Canada has, historically, been reliant on rail as a major means of grain transportation. However, from the railway point-of-view, particularly in the case of operations on some branch lines*, diseconomies are experienced, and in many cases, the rail lines operate in a loss position. There are a number of symptoms of the problem and these are:

- gradual decline of the services offered on branch lines
- gradual decline of the physical condition of the branch lines
- gradual decline of the physical condition of some elevators and the eventual closing of some of the elevators.

The Grain Handling and Transportation Commission, as one of its major functions, is involved in deriving long term solutions for the handling and transportation of Western Canada grains. Undoubtedly, a long term solution may well eliminate all but heavy density branch

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* See List of Definitions at the end of this section of the report.

lines. However, in the interim, the branch lines must be maintained such that these are gradually phased out to be replaced by a more efficient grain gathering system.*

This study is concerned with the interim time period. The question approached is: <u>What are the most reliable and least costly methods of maintaining branch line operations for a period of 10 to 15 years while a modified structure of grain handling and transportation evolves</u>? During this time frame, any operation recommended should not create difficulties for the grain producers but offer him a variety of options to enter the grain gathering process.

Eventually, the grain gathering system may alleviate additional grain handling costs through widespread utilization of inland terminals or the phasing of specific branch lines into the overall larger system. The former alternative can minimize additional handling costs if it includes for example:

- cleaning and/or partial processing of grain at facilities developed at transfer points
- solid grain train shipments from one point
- direct loading of ships at Thunder Bay, Vancouver and Churchill.

Thus it follows that branch line alternatives should be considered in relation to the present system with a view to the long range possibilities. This study looks at a number of alternatives for moving grain off branch lines and into the mainline traffic stream.

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* Such a system may evolve on the inland terminal concept.

It has been suggested that one appropriate solution to the branch line problem might include the use of a mini-train* transferring the grain to larger grain trains at strategically located transloading points on the main line*. Such an operation could result in a more efficient movement of grain on main lines and higher traffic density branch lines, as well as a less costly movement of grain from elevators located on light traffic density* branch lines.

Systems other than mini-trains with transloading facilities might also prove to be more efficient and reliable than conventional rail. These include short line* operations and trucking* to some main line point.

Other competing transportation systems can also be identified. Farm or commercial trucking direct to an inland terminal or main line elevator is an example and may be typical of the grain handling system after the end of the next decade. However, these systems represent operations exclusive of branch line utilization and were not considered in this study.

Study Objectives

The primary objective of the study can be stated as follows:

> "To examine the technical and economic feasibility of a mini-train system with transloading to a grain train. The implications of this system on producers, elevator companies and railways are to be considered as well as its effect on labour relations."

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* See List of Definitions at the end of this section of the report.

In addition to the operation of the mini-train system costs were developed for three systems capable of operation in a branch line area. In total, the four systems compared were as follows:

1) Mini-train with transloading facilities on the mainline.

2) Short line rail operation utilizing a power source designated to the branch line. Main line grain cars would be used. The short line power unit would deliver empty grain cars to the elevators and deliver full cars to the main line for train assembly.

3) Commercial trucking from the country elevator to the mainline. Transloading facilities are required at a common main line point in this alternative.

4) The do nothing alternative. In this alternative operations are carried out under the present system. The trackage if necessary is upgraded and maintained for 177 thousand pound rail cars operating at 20 miles per hour.

Main line costs of grain train operation expressed in cents per bushels can vary depending on the type of car used. However, these were no considered in this report.

Scope of Study

This study summarizes an analysis of the technical and economic feasibility of mini-train operations on light density branch lines. The study is structured as follows:

1) The four grain transportation and handling alternatives are considered.

2) A number of typical branch line areas are identified and described.

3) The technical, economic and labour implications of each of the alternatives as applied to the typical areas are examined.

4) A series of sensitivity analyses which were conducted are summarized. Parameter changes were made in rail line acquisition costs, grain volume, and track maintenance costs. The results of these sensitivity analyses were cross tabulated over the branch line areas.

5) Conclusions are drawn concerning the best applications for the mini-train, the short line and the trucking alternative.

List of Definitions

The following is a list of definitions of rail terms as used in this study:

1. A Branch Line is a rail line in Prairie Canada of light weight steel (85 pounds per yard or less) in such a condition as to limit the speed and/or weight of trains. That is, the larger rail cars cannot be fully loaded and trains are restricted to speeds of 20 miles per hour or less. Other than periodic grain shipments, there is very little other traffic on these lines.

2. A Main Line is part of the national rail network. The rails are generally of a weight of 110 pounds per yard and the rail bed is in good to excellent condition. All weights and freight car types can be handled. No dead weight or other shipping problems occur.

3. Light Density refers to the annual amount of grain handled on a particular branch line. Generally, 4.0 to 5.0 million bushels per year would be considered as the upper limits of a light density line.

4. Dead Weight is the unused capacity of a freight car. For example, if a box car has a capacity of two thousand bushels of wheat but because of a bridge condition it can only be loaded to 1,500 bushels the remaining 500 bushels is dead weight.

5. Mini-train. The mini-train concept is an independent rail operation on a branch line. It can be owned/operated by a major rail company, a grain company or an independent agent. The mini-train company will have as its rolling stock one power unit, some maintenance equipment, and a number of modified grain box cars. The mini-train company operates between the elevators on the branch line and a transloading facility on the mainline. At the transloading facility grain from the modified box cars is transferred to a mainline rail hopper car.

6. Short Line. The short line concept is an independent rail operation on a branch line. It can be owned/operated by a major rail company, a grain company or an independent agent. The short line rail company will have as its rolling stock one power unit and some maintenance equipment. The short line rail company operates between elevators on the branch line and the main line. The short line company delivers loaded main line grain cars to the main line for train assembly.

7. Trucking. The trucking concept is an independent trucking operation in a branch line area. It can be owned/operated by a major

rail company, a grain company or an independent agent. The rolling stock consists of a fleet of truck tractors and hoppered grain trailers. The trucking company delivers grain from the branch line elevators to a transloading facility on the main line.

8. Rail to Rail Transloading Facility. This is a system designed to transfer grain from the modified box cars of the mini-train company to covered hopper cars of a main line rail company.

9. Truck to Rail Transloading Facility. This is a system designed to transfer grain from the hoppered trailers of a trucking company to covered hopper cars of a main line rail company.

GRAIN HANDLING AND TRANSPORTATION ALTERNATIVES

The analysis which was conducted during this study examined a number of possible alternatives for handling and transporting grain in branch line areas. Although mini-train systems with transloading facilities may be shown to be more efficient than conventional rail on specific light density branch lines, other alternatives also exist which may, in certain instances, be even more attractive. A comparative analysis of a number of systems was conducted such that meaningful conclusions as to specific operations could be generated.

Specifically, four grain handling and transportation alternatives* were examined and these were:

1) an independently owned power unit operating on the branch line, utilizing specially constructed grain cars and a transloading facility on the main line; the mini-train alternative;

2) an independently owned power unit operating on the branch line delivering main line grain cars to/from the elevators for grain train assembly; the short line alternative;

3) commercial trucks carrying grain from the elevators to a transloading facility on the main line; the trucking alternative; and

4) continuation of the current system; the do-nothing alternative.

The above alternatives were examined both technically and economically as they apply to specific branch line areas. This section of the study describes each of the grain handling and transportation alternatives. They typical areas chosen for alternative evaluation are defined in the next section.

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* The detailed examination conducted in this study deals with maintaining or utilizing the country elevator system on the branch line. Direct farm delivery to main line elevators or inland terminals and over platform loading alternatives were not considered. The underlying reasoning was as follows:

- The concepts outlined are intended to utilize the country elevator for some time into the future, and
- This provides the grain companies with the opportunity to assess the future and gradually phase in new facilities to serve changing demands while eliminating the need for immediate large capital outlays.

The Mini-train Alternative

The mini-train concept is an independently owned/operated* rail line on a specific light density branch line. The rolling stock consists of a power unit, assorted maintenance equipment and modified grain box cars. The modified grain cars are loaded at the elevator and delivered to a transloading facility at the junction of the branch line and the main line. Here the grain is transloaded into a main line covered grain hopper car.

There are four major components to consider in the mini-train concept and these are:

- the power unit,
- the converted grain car,
- the transloading facility, and
- the country elevator.

-- The Power Unit: Technical Feasibility

A detailed description of the power units examined is provided in Appendix A**. Two alternative power units*** were examined and these were:

- a used diesel electric switching locomotive,
- a Whiting Corporation Model 11-TM Trackmobile.

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* The owner/operator might be a major rail company, a grain company or a third party agency.

** The Appendices of this chapter are not included in this volume of the report but are available upon request.

*** An off-track power unit was eliminated from consideration because of high capital requirements and technical problems. See Appendix A.

The diesel electric switching locomotive of approximately 70 tons weight generates a tractive effort of about 42 thousand pounds for train start-up. The technical capabilities of the switching locomotive can be summarized as follows:

- in cold weather the switching locomotive can start up to seventeen 80 ton box cars*,

- the engine can haul approximately 26 cars fully loaded at 20 miles per hour,

- on a 2.0 percent grade at 2.5 miles per hour the engine can haul approximately eleven loaded cars,

- restricting grades on the branch line examined were 1.0 percent to 1.5 percent. This engine can haul 17 to 20 fully loaded grain cars under these conditions, and

- the weight of switching engines runs from 65 to 70 tons. A loaded grain car will weigh up to 80 tons. Therefore, the weight of the engine is not a restricting factor.

Considering the above remarks, the diesel switching locomotive has the technical capabilities for operation of the mini-train concept.

The Whiting 11-TM Trackmobile has a gross weight of 60 thousand pounds. With reference to Figure A.3, page A.8**, the trackmobile

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* A weight of 80 tons is more or less equivalent to a grain box car loaded with two thousand bushels.

** The Appendices of this chapter are not included in this volume of the report but are available upon request.

borrows weight from the adjacent rail car through the use of hydraulic jacking couplers. The effective weight of the engine becomes:

- with one coupler, 100 thousand pounds.
- with two couplers, 140 thousand pounds.

This gives a maximum tractive force of 42 thousand pounds with two couplers and 30 thousand pounds with one coupler.

Considering one coupler* in use, the following can be concluded:

- the TM-11 can start up to twelve 80-ton box cars in cold weather,
- at 20 miles per hour, the TM-11 can pull approximately** 12 fully loaded grain cars,
- on a 2.0 percent grade at 2.5 miles per hour, the TM-11 can haul approximately five box cars,
- on the limiting 1.0 to 1.5 percent grades, the TM-11 can haul seven to eleven grain cars, and
- the weight of the engine is not a controlling factor.

Considering the above remarks, the Whiting TM-11 Trackmobile also has the technical capabilities for operation of a mini-train.

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* One coupler in use is the most likely type of operation for the TM-11 on a branch line.

** Numbers given are approximate since power tractive curve was not available.

-- <u>The Power Unit: Economic Feasibility</u>

Appendix 'A"* summarizes the economics of operation of the diesel switching engine and the TM-11 Trackmobile. The power unit economics are summarized as follows:

1) Diesel Electric

- Capital Outlay Annual charge over 15 years at a 10.0 percent interest rate	$10,518
- Annual Maintenance Schedule Costs per operating hour	$1.57
- Fuel Charges Costs per operating hour	$3.88
- Total Variable Costs per operating hour (Fuel and Maintenance)	$5.45
- Total Annual Costs for one thousand hours of operation**	$15,968

2) TM-11 Trackmobile**

- Capital Outlay (annual cost)	$21,276
- Annual Maintenance Schedule Costs per operating hour	$1.09
- Fuel Charges Costs per operating hour	$3.65
- Total Variable Costs per operating hour (Fuel and Maintenance)	$4.74
- Total Annual Costs for one thousand hours of operation**	$26,016

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* The Appendices are available on request.

** In the applications examined, one thousand hours of operation is more or less typical.

*** Maintenance schedule was simulated from available data as was fuel consumption.

-- <u>Comparison of Power Units</u>

Table V-2 compares the diesel switching locomotive with the TM-11 Trackmobile. Both engines can technically perform the work required of a mini-train or short line operation. The diesel electric switching locomotive is the better choice because of the lower annual cost of $16 thousand as compared to $26 thousand for the TM-11 Trackmobile.

-- <u>Grain Car Modifications</u>

Appendix 'B'* summarizes the grain car modification analysis. In all, five alternatives were examined and these were:

- Alternative I: conventional grain cars with a side car dumper
- Alternative II: grain car with bottom trap doors, no hoppering
- Alternative III: grain car with two hoppers and two bottom gates
- Alternative IV: grain car with four hoppers and four bottom gates
- Alternative V: grain car with longitudinal hoppering and seven trap doors along the bottom of each side.

The side car dumper was too costly. Alternative II presented unloading problems. Alternative III and Alternative IV resulted in a 40 percent loss of payload capacity along with stability problems. Alternative V was chosen as the best solution.

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* The Appendices are available upon request.

TABLE V-2

COMPARISON OF POWER UNITS

DIESEL ELECTRIC vs. TM-11 TRACKMOBILE

TECHNICAL	Diesel Locomotive	TM-11 Trackmobile (one coupler)***
Maximum Tractive Force	42,000 lbs.	30,000 lbs.
Grain Cars* started in cold weather	17	12
Grain Cars Hauled on 2.0 percent Grade	11	5
Weight (approximate)	70 tons	30 tons**
Technical Feasibility of Operation	yes	yes
Economic		
Annual Cost of Capital	$10,518	$21,276
Operating Cost per Annum (one thousand hours)	$5,450	$4,740
Total Annual Costs	$15,968	$26,016

* Grain box cars with a gross weight of 80 tons.

** Engine weight increases to 50 tons with one hydraulic jacking coupler in use and 70 tons with two couplers in use.

*** The TM-11 Trackmobile with one coupler in use is the most likely form of operation on a branch line.

Figure V-2 is a schematic of the suggested grain car modifications. Only 25 percent of the payload is lost and most of the box car stability is retained. The car* will carry 1,500 bushels (two modified cars will provide full load for a hopper car).

The estimated cost of the box car modification is $2,033.00. (See Table B.1, Page B.8)** Capital outlay for a used steel box car is $5,400.00. Total costs for capital and modification are $7,433.00 per car.***

-- <u>Rail to Rail Transloading Facility</u>

Figure V-3 is a plan view of the rail to rail transloading facility. A cross-sectional view is given in Figure V-4. Detailed cost estimates and design are summarized in Appendix C.**

The cost of the rail-to-rail transload was estimated at $47,092 plus the cost of two car pullers ($19 thousand), shelter ($5 thousand), site development ($10 thousand), rail siding ($100 thousand) and sales tax at $28,975 for a total cost of $210,067.

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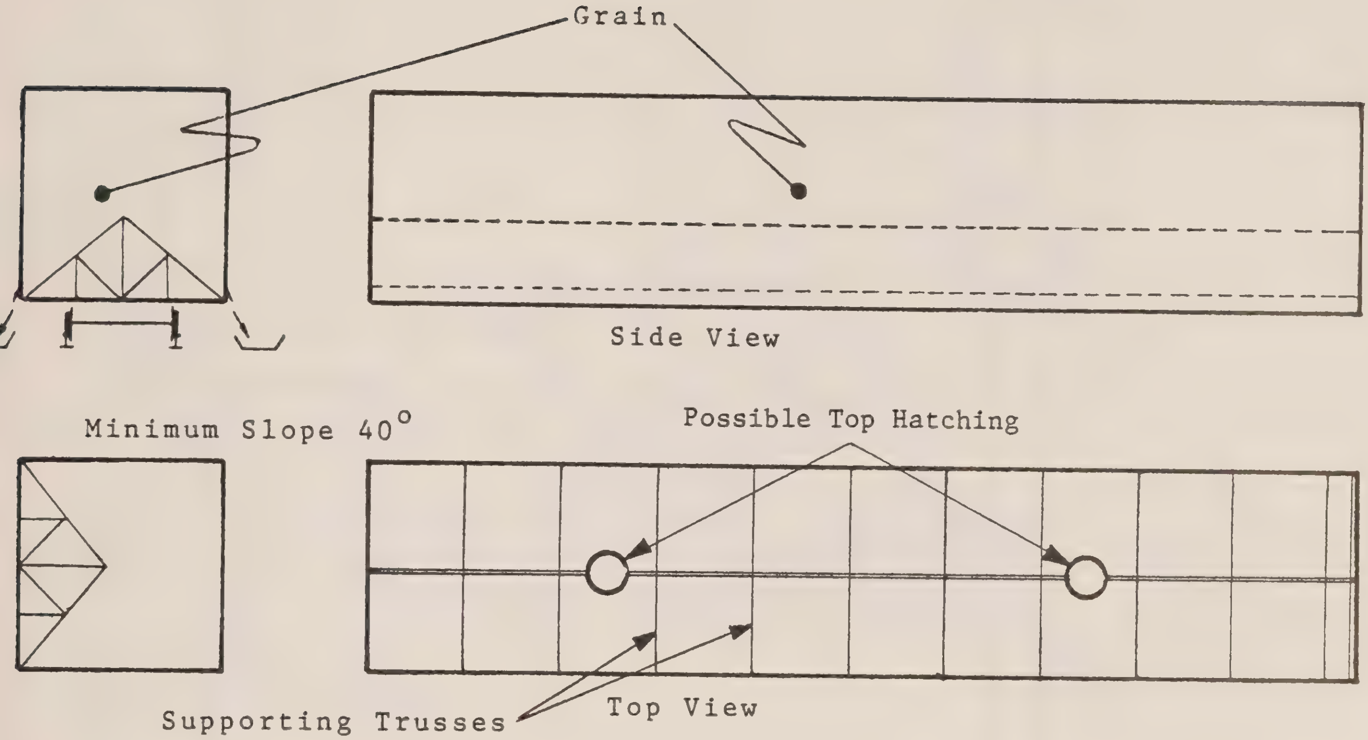
* If necessary or desired, the car can be top hatched to facilitate loading.

** The Appendices are available upon request.

*** Used steel box cars are available in North America mainly from American railway companies.

FIGURE V-2

SUGGESTED GRAIN CAR MODIFICATION



Raise center of floor approximately 3½ feet to form 2 hoppers the length of the car. Install 7 hinged flap doors down each side of the car.

Result:

1. The car will empty by gravity.

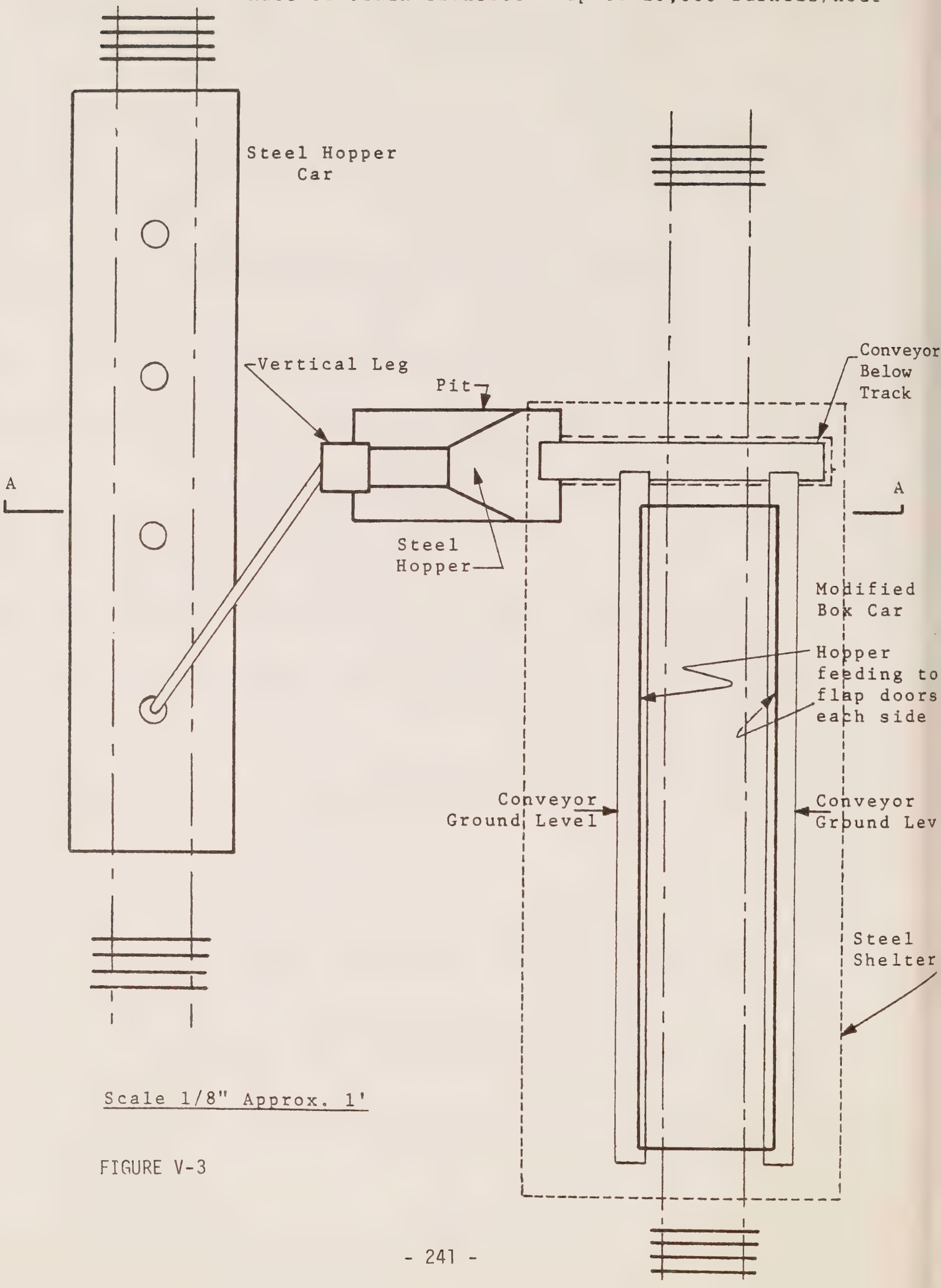
2. 25% of the volume is lost. The car will carry 1,500 bushels.

3. The center of gravity of the wheat is raised only 3 - 4 inches retaining most of the stability of the car.

4. If necessary or desirable, the box cars can be top hatched to facilitate loading.

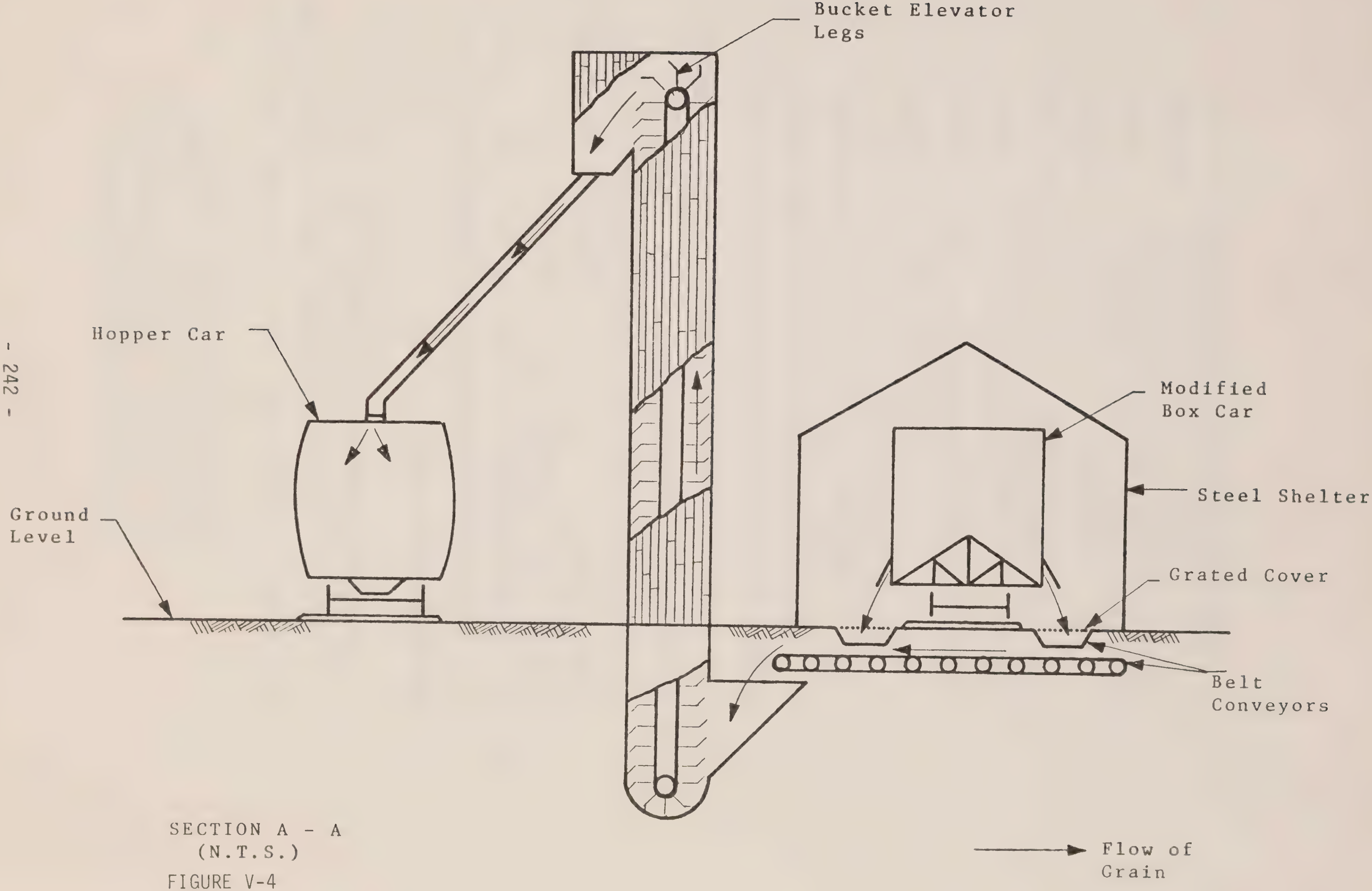
TRANS LOAD RAIL TO RAIL

Rate of Grain Transfer - up to 10,000 Bushels/Hour



Scale 1/8" Approx. 1'

FIGURE V-3



SECTION A - A
(N.T.S.)
FIGURE V-4

The total annual costs were estimated as follows:

- Labour	$26,000.00
- Electrical Power	2,142.00
- Maintenance	5,755.00
- Depreciation	30,198.00
- Insurance	307.00
- Taxes (property)	1,000.00
- Administration	500.00
Total Annual Costs	$65,902.00

This operation can have an annual throughput of 7.5 million bushels per year based on an eight hour day, five days a week. This capacity is adequate for volumes of grain anticipated on a branch line utilizing a mini-train system.

No technological problems are anticipated with the trans-loading facility.

-- <u>The Country Elevator</u>

In the mini-train alternative, the branch line elevators require no modification.

-- <u>Mini-train Alternative Grain Handling Feasibility</u>

There are a number of limitations imposed on the grain handling aspects of the mini-train alternative: These are:

1) the modified grain cars must be delivered to the elevator in multiples that equal the capacity of a grain car. In the design presented herein, each converted grain car has a capacity of 1,500 bushels. Therefore, the modified box cars must operate in pairs.

2) the grade and type loaded to any two converted cars should be identical. While this may present no problem from one specific elevator, an appropriate marshalling may be required for shipments coming from two elevators, particularly if the elevators are of different companies.

3) weight loss at the transloading facility must be restricted to 60 pounds or less from both of the modified cars.

4) some grain quality may be lost at the transloading facility.

None of the above restrictions are insurmountable, although some additional handling costs will be incurred in attempting to trade-off the overall transportation cost components. It is unlikely that these costs will be incurred by the producers. However, some form of compensation less than or equal to current rail subsidies may be required for one or more parties involved.

The Short Line Alternative

The short line concept is an independently owned/operated rail line on a specific light density branch. The rolling stock consists of a power unit and assorted maintenance equipment. The short line rail company delivers loaded grain cars from the elevator to the main line for main line train assembly.

There are four major components to consider in the short line concept and these are:

- the power unit
- the grain car
- a main line siding
- the country elevator.

-- The Power Unit

The power unit suitable for the short line rail company is a used diesel electric switching locomotive. (See Table V-2)

-- The Grain Car

Main line railway company grain cars are used in this alternative. The cost to the short line rail company is a demurrage charge of #8.00 per day over 48 hours. A four day turn-around was estimated. Thus, a demurrage charge of $16.00 per box car was used in this study.

-- Main Line Siding

In the short line alternative, the rail-to-rail transloading facility is eliminated. The grain cars are delivered to a main line siding. In the areas examined, all had appropriate sidings at the branch line - main line junction. Thus the cost of such a siding was not estimated.

-- The Country Elevator

No modifications to the country elevator are required in the short line concept.

-- Short Line Grain Handling Implications

The short line alternative is simply a train assembly operation. There are no changes to the current grain handling system.

The Trucking Alternative

The trucking alternative consists of an independently owned/operated trucking fleet assigned to a specific light density branch line area. The rolling stock consists of an appropriate number of truck tractors and hoppered trailers. The trailers are loaded at the elevator and trucked to a main line point. A truck-to-rail transloading facility is used to transfer the grain from the hoppered trailers to a main line covered rail hopper car.

There are four major components to consider in the trucking concept and these are:

- the truck tractor
- the hoppered trailer
- the transloading facility
- the country elevator.

-- The Truck Tractor

The costing of the trucking operation is detailed in Appendix D* and summarized below.

The annual fixed costs of the truck tractor unit were estimated on a full maintenance lease which included capital, interest,

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* The Appendices are available upon request.

maintenance, licensing and insurance. The total annual cost of the tractor unit is:

- lease arrangement*	$15,600
- 20 percent contingency	3,120
- total annual costs	$18,720

The variable per mile costs of the truck tractor were as follows:

- flat rate	$0.10 per mile
- fuel	0.12 per mile
- drivers' wages	0.17 per mile
- contingency 10.0 percent	0.039 per mile
- total per mile costs	$0.429 per mile

-- <u>The Hoppered Trailer</u>

The trailer has a tare weight of 12 thousand pounds and a maximum payload of 55 thousand pounds or 1,100 bushels. The cost of the trailer is $12 thousand which translates to an annual capital cost of $2,416.00. Adding a 20 percent contingency, total annual cost of the trailer is $2,900.00

The variable cost of the trailer included the following:

- tires	$0.0132 per mile
- brakes	0.003 per mile

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* Premiere Truck Leasing: LT 9000 Ford Diesel Tractor. 318 HP. Tandemaxle. Based on a three year lease. A flat rate of 10 cents per mile is applied as a variable cost.

- miscellaneous	$0.007 per mile
- 10 percent contingency	0.0023 per mile
Total	$0.0255 per mile.

Total per mile costs for the tractor and trailer unit are $0.4545

Ton-mile costs for the tractor trailer unit based on varying revenue miles per year and on varying payloads are summarized in Figure D.2, page D.8*. For example, at 30 thousand revenue miles per year and a payload of 23.25 tons** (approximately 830 bushels) a ton-mile cost of 6.8 cents can be anticipated.

-- The Transloading Facility

Figure V-5 is a plan view of the truck-to-rail transloading facility. A cross-sectional view is shown in Figure V-6. Detailed cost estimates and design are summarized in Appendix F.*

The cost of the truck-to-rail transborder was estimated at $35,892 plus the cost of a car puller ($9,500), shelter (two thousand dollars)*** , site development ($10 thousand) and taxes ($9,183) for a total capital outlay of $66,575.00.

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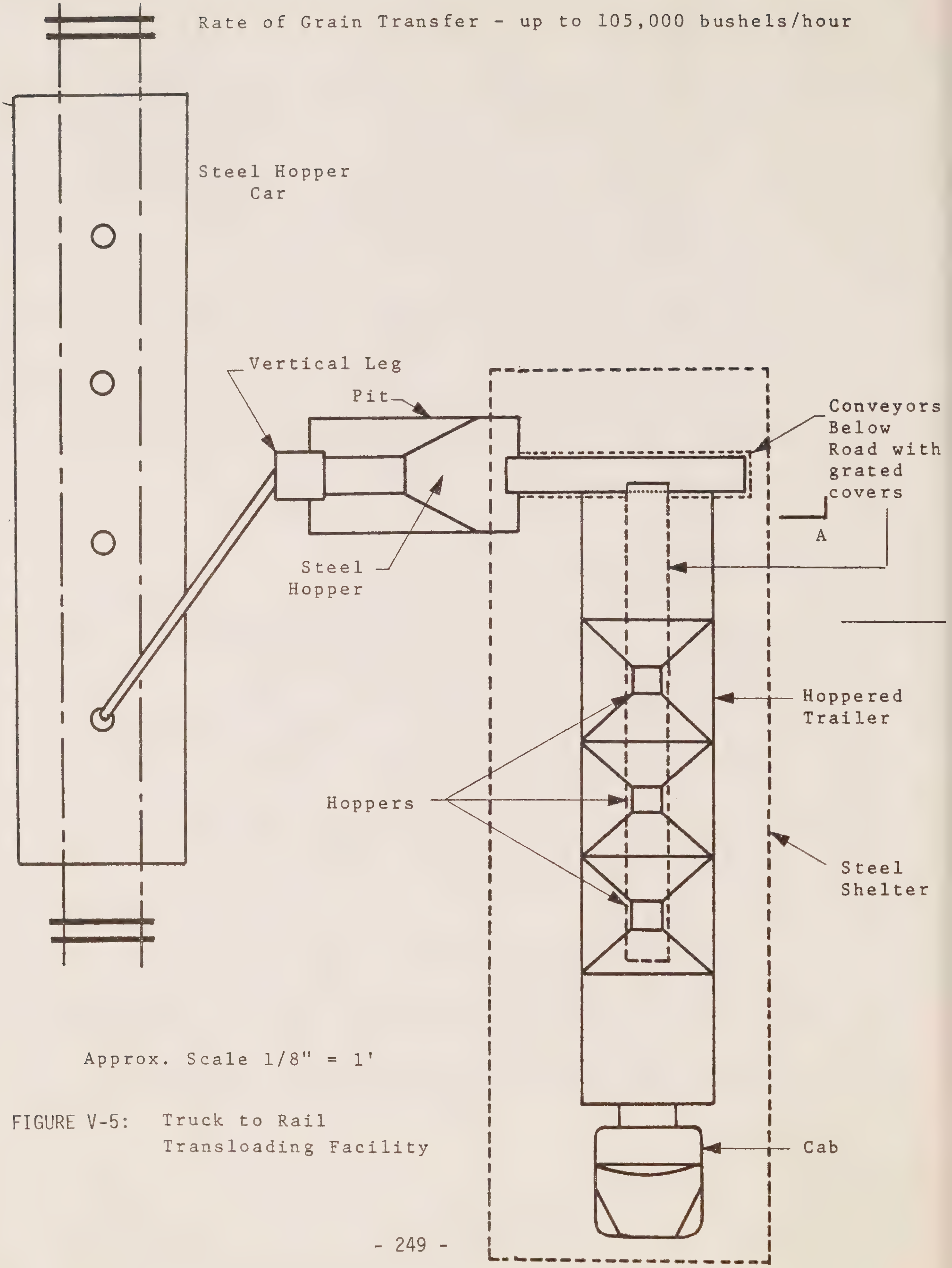
* The Appendices are available upon request.

** This payload is achievable on most roads and highways in Western Canada that have load restrictions of 74 thousand pounds G.V.W.

*** The required truck shelter is much smaller than the rail car shelter.

TRANS LOAD TRUCK TO RAIL

Rate of Grain Transfer - up to 105,000 bushels/hour



Approx. Scale 1/8" = 1'

FIGURE V-5: Truck to Rail Transloading Facility

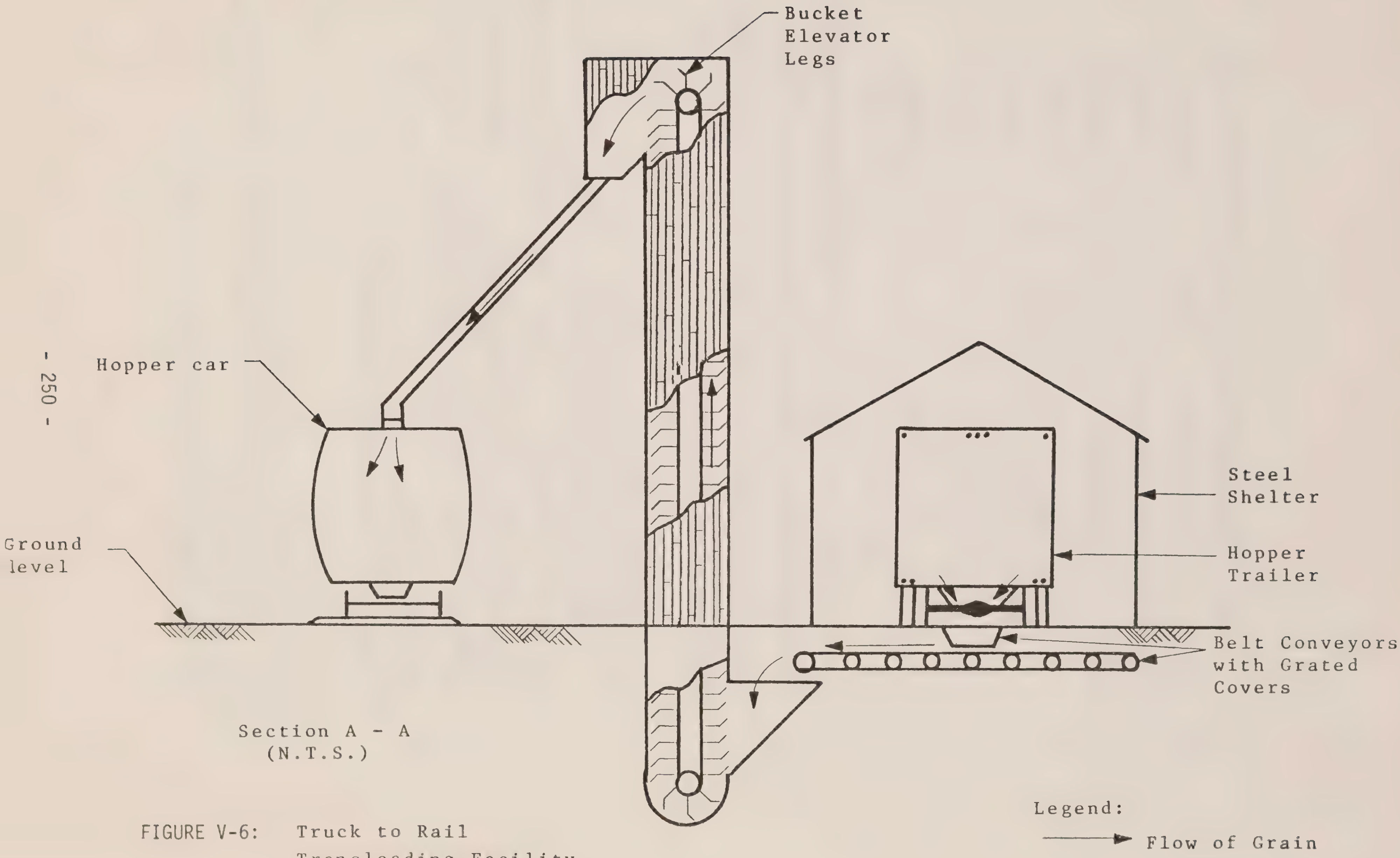


FIGURE V-6: Truck to Rail Transloading Facility

Total annual operating costs were estimated as follows:

- Labour	$26,000.00
- Electrical power	1,338.00
- Maintenance	2,870.00
- Depreciation	10,472.00
- Insurance	286.00
- Taxes	750.00
- Administration	500.00
Total Annual Costs	$42,216.00

This operation could have an annual throughput of about ten million bushels* based on an eight hour day and a five day week. The capacity is more than adequate for branch line operations for the areas examined.

-- <u>The Country Elevator</u>

Appendix E** details the required elevator alterations for the trucking alternative. A roadway and loading pad are required. These alterations are estimated at a cost of $5 thousand each. Additional annual maintenance was estimated at $200 per elevator per year. Figure E.1 and Figure E.2 (pp. E.2 and E.3) are schematics of the required loading pads.*

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* The rail-to-rail transloading facility has less capacity (7.5 mm. bushels per annum) due to the need to position two rail cars and subsequent time lost.

** The Appendices are available upon request.

-- Trucking Alternative Grain Handling Feasibility

There are a number of limitations imposed on the grain handling aspects of the trucking alternative.* These are similar to the mini-train restrictions with the following exceptions:

1) loading of the hopper cars will be from three or four trailers depending on the loading restrictions in the area, and

2) weights and grades of grain must be consistent across the trailers used.

Again these restrictions are not insurmountable.

The Do Nothing Alternative

The do nothing alternative consists of a continuation of the current system. That is the main line rail companies will continue to operate on the branch lines. Cost components of the do-nothing alternative were estimated as follows:

1) required capital to upgrade the branch line to minimum standards sufficient for operation to a 15 year planning horizon (if such capital is required),

2) all on-line operating costs as identified in rail submission to the Canadian Transport Commission under Section 258 of the Railway Act less current maintenance, and

3) a maintenance charge of $1 thousand per track mile per annum** required for maintaining the line.

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* Other aspects of shipping grain by truck are discussed in 'A Profile of Commercial Grain Trucking in Saskatchewan" by Clayton, Sparks and Associates Ltd. October 1975.

** See Table I.9, Appendix I. (Available upon request).

A Comparison of Alternatives

Table V-3 provides a comparison of the grain handling and transportation alternatives. The comparison is summarized as follows:

1) All power units for the four alternatives possess the technical capability for operation.

2) The most expensive power unit is the truck tractor with an annual cost of about $19 thousand.

3) The truck tractor also has the highest per hour operating costs.

4) The short line and do nothing alternatives will use the same grain cars as at present. Demurrage charges for the short line may run to $16 per grain car. Capital outlay for the modified grain cars for the mini-train are estimated at $7,433 per car and for the trucking at $12 thousand per trailer.

5) Transloading facilities are required for the mini-train and trucking alternatives. Capital outlays are $210 thousand and $67 thousand respectively. This translates to an annual cost of $65.9 thousand (mini-train) and $42.2 thousand (trucking). Both facilities have adequate capacity.

6) Some grain handling restrictions are anticipated with the mini-train and trucking concepts. Each of these alternatives must load multiple cars of grain equal to the capacity of a covered hopper car. Although the restrictions are not insurmountable, additional handling costs are incurred.

Summary

1. Four grain handling and transportation alternatives as these apply to light density branch lines were reviewed in this chapter.

TABLE V-3

GRAIN HANDLING AND TRANSPORT ALTERNATIVES

- COMPARISON -

Component	Mini-Train	Short Line	Trucking	Do Nothing
Power Unit	Diesel Electric	Diesel Electric	Truck Tractor	Diesel Electric
Technical Capability	good	good	good	good
Capital Outlay	$80,000	$80,000	$37,500	as current
Annual Capital	10,518	10,518	18,720	as current
Operating Cost/Hour*	$5.45	$5.45	$10.36**	as current
Grain Cars				
Technical Capability	good	as current	hoppered trailer	as current
Capital Outlay	$7,433 per car	n.a.	$12,000 per trailer	as current
Annual Capital	$977	$16 per car***	$2,416	as current
Maintenance Costs	$200 per annum	as current	$890 per annum ****	as current
Transloading Facility				
Technical Capability	good	n.a.	good	n.a.
Capital Outlay	$210,067	n.a.	$66,575	n.a.
Annual Capital	$ 65,902	n.a.	$42,216	n.a.
Capacity	7.5 mm bu./year	n.a.	10.0 mm bu./year	n.a.
Elevator				
Total Capital	n.a.	n.a.	$5,000	n.a.
Annual Capital	n.a.	n.a.	$660	n.a.
Maintenance Costs	n.a.	n.a.	$200	n.a.
Grain Handling	some problems	as current	some problems	as current

* Excludes wages
** Based on 40 miles driving per hour
*** Two days demurrage per car
**** Based on 35,000 miles per annum

2. These alternatives are:

- mini-train which operates a power unit on a branch line delivering loaded and modified grain cars from the elevator to a transloading facility on the main line for transfer of grain to a covered hopper car,
- short line which operates a power unit on a branch line delivering standard grain box cars from the elevator to the main line for train assembly,
- trucking from the current elevator to a trans-loading facility at the main line. Hoppered trailers will be unloaded to covered hoppered grain cars, and
- current system or the do nothing alternative.

3. The power unit exhibiting the technical capabilities and operational economics for the mini-train and short line alternatives was a 70 ton diesel electric switching locomotive.

TYPICAL BRANCH LINE AREAS

Four grain handling and transportation alternatives were defined in the preceding section. A sound basis on which to make recommendations concerning the application of any of the alternatives can be developed by simulating the operational impacts of the alternatives on typical branch lines. Three such areas were chosen for investigation. These branch lines are described in this section and are the Lyleton area of Manitoba, the Riverhurst-Main Centre area of Saskatchewan and the Cardston-Whisky Gap and Glenwood area of Alberta. Actual areas were chosen to provide a basis on which to simulate the operational

economics of the four transport alternatives. The three areas chosen exhibit a reasonable range of branch line length, grain volumes handled and permissable highway loadings. Because of the parameter variation across the three areas, conclusions can be made as to the overall applicability of the four grain handling and transportation alternatives.

Two further branch line areas were chosen for qualitative assessment of possible labour problems. The Dunelm, Pennant and Stewart Valley subdivisions are three short branch lines that intersect the main line in the Swift Current area. Possible labour problems are posed because of the necessity for a power unit serving all three branch lines* to operate on a section of the main line joining the three subdivisions. The Coronation subdivision was chosen to examine any labour problems associated with crossing provincial boundaries (in this case the Alberta - Saskatchewan border).

The objective of this section of the chapter is to describe the three areas chosen for economic evaluation. The labour implications associated with all five areas are also identified.

<u>Area Selection Process</u>

A number of typical branch line areas were identified for study. The selection process was as follows:

1) a number of branch line areas in the three provinces were selected.

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* A preliminary assessment of the three branch lines suggested that because of length, grain volumes and economics, one power unit would be sufficient to serve the needs of the subdivision.

2) each of these areas was examined with respect to the following:

   - length of branch line,
   - physical condition of branch line,
   - number of operating elevators on the branch line and their location relative to the main line,
   - annual throughput of each elevator,
   - current rail operating costs* on the branch line,
   - the highway infrastructure, and
   - current load restrictions on the various highway sections;

3) following the selection of the areas, a presentation was made to the Grain Handling and Transportation Commission Steering Committee for study. As a result of that meeting five areas were selected as typical: three for detailed economic and technical evaluation, one for qualitative labour implication assessment and one for a qualitative assessment of operational problems.

The areas examined were selected as typical. However, it is not the intention of this study to associate a specific alternative with a particular region.

Area I: Lyleton

Figure V-7 is a map of the Lyleton area. The branch line (Lyleton Subdivision) joins the main line at Deloraine. Appendix I** provides

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* Current rail operating costs were derived from CNR/CP Rail Submissions to the Canadian Transport Commission under Section 258 of the Railway Act.

** The Appendices are available upon request.

a detailed description of the Lyleton area. Some of the features of Area I are described as follows:

1) the branch line is 37.4 miles in length,

2) the rail line is in poor condition and will require substantial investment to bring the facilities up to a minimum standard,

3) restricting highway load limit in Area I is 74 thousand pounds, Gross Vehicle Weight (G.V.W.),

4) total volumes of grain handled in Area I amounted to 1.9 million bushels per year,

5) average weight per bushel is 55.6 pounds,

6) there are five elevator points in Area I,

7) the rail transport production* of Area I was 1.1 million ton-miles at an on-line cost of $125 thousand per annum,** and

8) required truck transport production would be 1.3 million ton-miles.

Area II: Cardston

Figure V-8 is a map of the Cardston area. There are two subdivisions in this area and these are:

- Woolford Subdivision
- Cardston Subdivision.

The main line is joined at Raymond, Albert

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* Net ton-miles required to move grain from elevator points to the main line.

** From CP Rail/CNR Submission to the Canadian Transport Commission under Section 258 of the Railway Act.

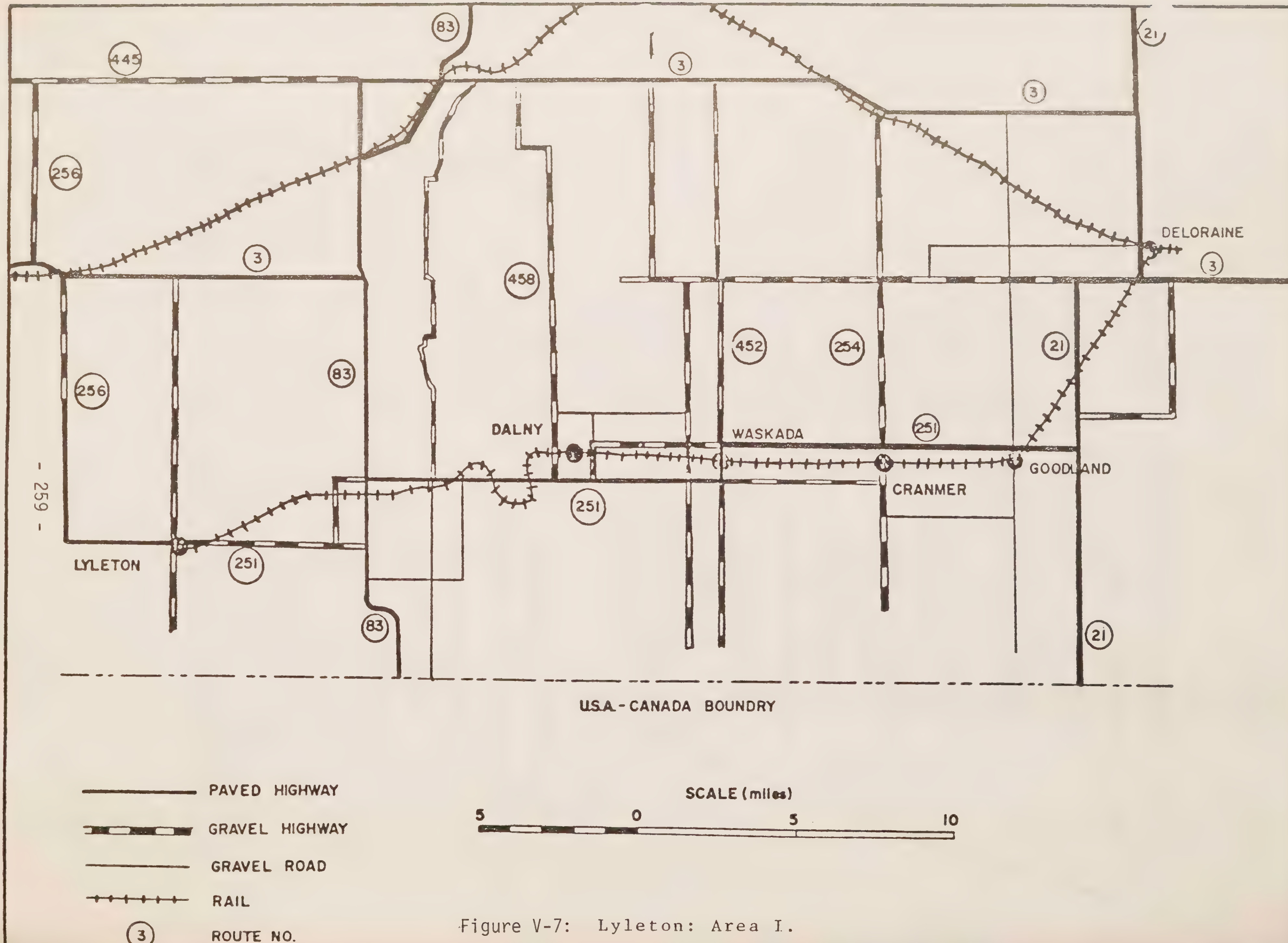

Figure V-7: Lyleton: Area I.

Some of the features of Area II* are described as follows:

1) the two branch lines have a combined 95.0 miles of rail,

2) the physical condition of the rail line can be classified as reasonable,

3) restricting highway load limits in the Cardston area are 45 thousand pounds Gross Vehicle Weight (G.V.W.), 59 thousand pounds G.V.W. and 110 thousand pounds G.V.W. from different elevator points,

4) total volumes of grain handled in Area II amount to 3.1 million bushels per annum,

5) composite weight of grain in the area is 56.5 pounds,

6) there are nine elevator points in Area II,

7) the rail transport production is 2.8 million ton-miles at an annual cost of $357 thousand, and

8) required truck transport production would amount to 2.8 million ton miles.

Area III: Riverhurst - Main Centre

Figure V-9 is a map of the Riverhurst - Main Centre area. There are three rail subdivision in Area III and these are:

- the Central Butte Subdivision, west of Moose Jaw**
- the Main Centre Subdivision
- the Riverhurst Subdivision.

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* Area II is described in detail in Appendix J which is not included in this volume of the report but is available upon request.

** The Central Butte Subdivision extends as far east as Regina.

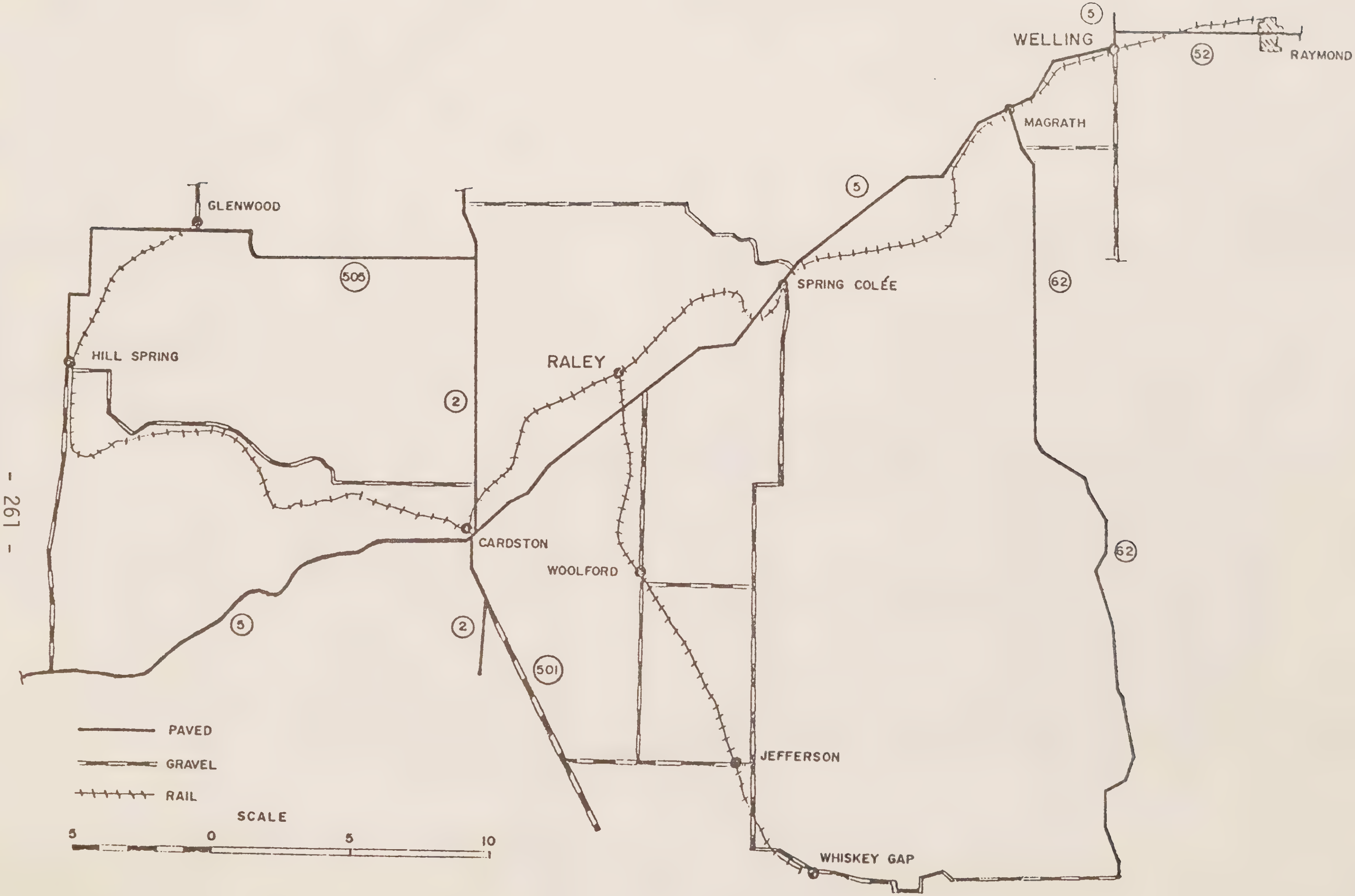

Figure V-8: Area II: The Cardston Area

The main line is joined at Moose Jaw.

Appendix K* details the Riverhurst - Main Centre region. Some of the features of Area III are described as follows:

1) total branch line trackage amounts to 119.0 miles,

2) the physical condition of the trackage is fair,

3) the restricting highway load limit is 74 thousand G.V.W.,

4) total volumes of grain handled in Area III are 3.9 million bushels per annum,

5) the composite average weight of grain is 58.0 pounds per bushel,

6) there are 14 elevator points in Area III,

7) the rail transport production of Area III is 6.5 million ton-miles at an annual cost of $549 thousand, and

8) the required truck transport production would amount to 7.4 million ton-miles.

Comparison: Area I, Area II and Area III

The four grain handling and transportation alternatives will be applied to these areas. Table V-4 illustrates the wide variation in the three areas. The comparative table can be summarized as follows:

1) the variation in branch line length is from 37.4 miles to 119.0 miles. This provides a good range of mileage.

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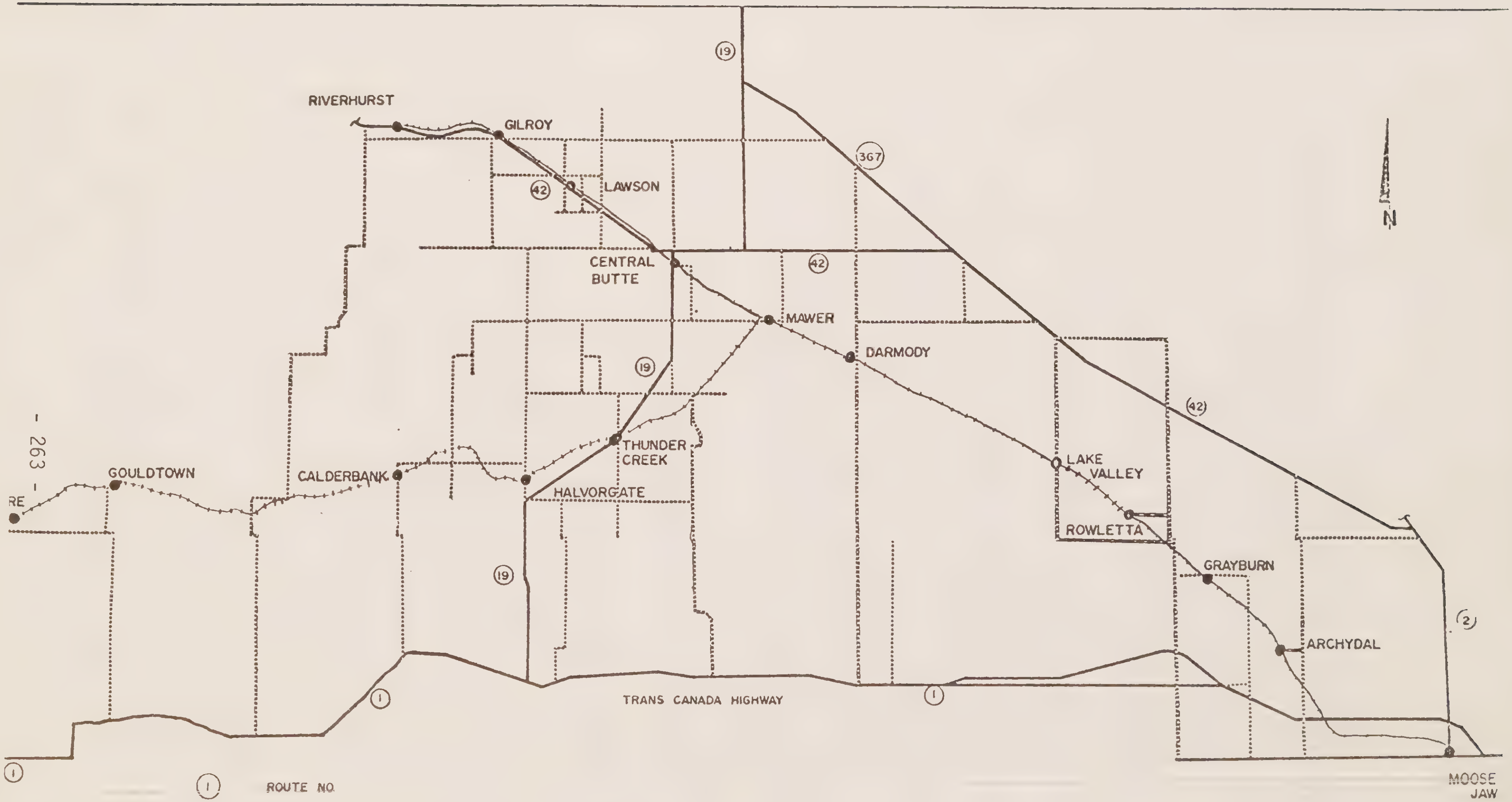
* The Appendices are available upon request.



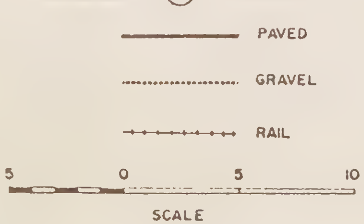


Figure V-9: Area III: Riverhurst - Main Centre

2) One track (Area I) is in poor condition requiring substantial upgrade. This is costed out in the analysis. A sensitivity test treating the track as if it were in reasonable condition is also presented.

3) Maximum allowable highway loads range from 45 thousand pounds G.V.W. to 110 thousand pounds G.V.W.

4) Grain volumes handled also provide a wide range for examination of from 1.9 million bushels per annum to 3.9 bushels per annum.

5) Consistent with the grain volumes, the elevator points also range from 5 to 14 respectively.

6) Transport production requirements by rail and truck also vary significantly.

This comparison illustrates the wide variation in parameters that will be examined in the evaluation.

Labour Implications*

The objective of this part of the section is to discuss the labour implications that might be associated with the implementation of the grain handling and transportation alternatives (except the do nothing alternative). These remarks would apply not only to the three areas that have been described, but also to other typical branch lines.

In the short term, the least disruptive alternative, from a labour standpoint, is the do nothing alternative. All of the others imply that the present national carrier would no longer be involved in the branch line operation.

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* The labour implications discussed herein were derived from private conversations with Mr. J.F. McGee, Senior Partner, Hickling-Johnston Limited. Mr. McGee specializes in labour negotiations.

TABLE V-4

COMPARISON OF AREA I, AREA II, AREA III

Component	Area I	Area II	Area III
Branch Line Length (Miles)	37.4	95.0	119.0
Track Condition	Poor	Fair	Fair
Limiting Highway Load Limit (Pounds)	74,000	45,000	74,000
Grain Volumes (Bushels)[1]	1.9 mm	3.1 mm	3.9 mm
Elevator Points	5	9	14
Rail Transport Production (ton-miles	1.1 mm	2.8 mm	6.5 mm
Annual Rail Cost ($Thousands)[2]	125	357	547
Required Truck Transport Procution (ton-miles)	1.3 mm	2.8 mm	7.4 mm

Source: 1. Canadian Grain Commission 'Summary of Primary Elevator Receipts at Individual Prairie Points: Crop Year 1973/74'.

2. CNR/CP Rail Submissions to Canadian Transport Commission under Section 258 of Railway Act.

If the grain handling system were changed on only a few branch lines in Western Canada, it is anticipated that there would be little adverse impact on the labour situation. That is, all current employees could be absorbed into the present system or be taken care of by attrition since only a small percentage of their time is spent on any single light density branch line.

However, if there were a large scale shift to one of the above alternatives, the national carrier would be faced with layoffs and subsequent labour difficulties due to loss of jobs. These difficulties would be encountered for any change to the present system and would not be associated with a specific alternative.

From the national carriers' viewpoint, many of these lines should be closed. Therefore the solving of the loss of jobs situation due to abandonement is one that the carriers will have to face as a matter of course in the closing of branch lines. The actual solving of these anticipated labour problems is beyond the scope of this study but they are not deemed to be overwhelming.

Other labour problems are believed to be of a minor nature in comparison to the large scale abandonment or transfer of jurisdiction of branch lines.

The labour involved at the transloading facility for both the mini-train and trucking alternatives should be the responsibility of the grain companies that own elevators along the line. From the labour point of view the most ideal situation would occur if a single grain

company owned all of the elevators along the line.*

The key words in setting up a trucking system, mini-train system or a short line system is to keep the business small and operate on a non-union basis.

<u>Area IV and Area V</u>

In certain instances, more complex problems may arise. This section of the report considers two other typical areas. In Area IV, an operational and associated labour problem is illustrated. Area V is typical of branch lines that cross provincial boundaries.

<u>Area IV</u>

Area IV consists of a series of three short branch lines, each less than 25 miles in length, with end points on a main line less than 20 miles apart. The three subdivisions are the Dunelm, the Pennant and the Stewart Valley. All join the main line in the Swift Current area.

The grain cars from these lines would be assembled or transloaded at a common point on the main line. The branch line railway would be operated by a third party, that is, by a non-national carrier. However the power unit that would be used would have to run over main line track with automatic block signals and would incur significant operational problems. Federal jurisdiction would become an issue concerning

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* This would provide the highest degree of co-ordination between elevator points along the branch line.

equipment operating on the lines of a national carrier. The utilization of labour would create difficulties and would have to be dealt with before joint running rights could be considered in view of the national carriers' labour agreements with their employee unions.

Employees of the mini-train or short line operation running over national carriers' trackage would be required to conform to the "Uniform Code of Operating Rules". A very serious situation could develop if the operator were to interfere with main line traffic while travelling between these branch lines.

Although these problems are significant, they can be overcome. The integrated co-operation of the major railway company(s) in this type of situation would be essential. However, these problems would not be encountered if the power unit were confined to a single "dead end" line.

Area V

The branch line in Area V is the Coronation Subdivision. It is 107 miles in length and handles a little over 4.0 million bushels of grain annually. This branch line is different from those in the other areas only because it crosses the Alberta - Saskatchewan boundary at Compeer. The labour statutes of each of the Provinces involved would have to be examined in detail. The operator of the mini-train and short line alternatives would have to conform to the labour statutes of each Province as well as the Federal labour statutes. However, these are not deemed to be overly restrictive. The biggest problem in the labour areas

would be the negotiation of the change in jurisdiction. That is, the National Carrier would no longer operate on the branch line in question. This would be the case for all but the do nothing alternative.

Summary

1. This section of the report identified three areas which will serve as a basis for costing out the four grain handling and transportation alternatives.

2. A comparison of the three areas indicated a wide range of parameters including length of branch line, grain handled and highway loading limitations.

3. The labour implications of the four alternatives were reviewed. It was felt that if a small number of branch lines changed to any of the alternatives few labour problems would be experienced. If a large number of branch lines changed in operation, loss of railway jobs could occur creating significant labour disruption. However, the labour implications were not deemed as insurmountable.

4. Two other branch line areas were examined, one with respect to operational problems and one with respect to the labour implications concerned with crossing a provincial boundary.

5. Operational problems of assigning one power unit to several short branch lines could be significant if the power unit is not equipped to run on the main line between the branch lines.

6. No insurmountable labour problems are foreseen in crossing a provincial boundary.

EVALUATION METHODOLOGY

Four grain handling and transportation alternatives for application to light density traffic branch lines have been identified. Three typical branch lines have also been described. It is the objective of this section of the study to summarize the operational economics methodology that was applied to each of the typical branch line areas.

The alternatives do not consider ways and means of handling grain which farmers wish to ship through "platform cars". Grain producers who wish to ship grain directly in car lots to terminals or to end users could do so by loading cars spotted for them on sidings on the main line. They would also be able to load cars spotted along the branch line in the 'do nothing' situation. It is questionable whether it would be possible or desirable to make arrangements to ship grain directly under the mini-train or trucking alternatives. However, the short line system would offer possibilities.

Costing Methodology

This section of the report reviews the costing methodology by grain handling and transportation alternatives. The methodology was consistent over the three areas and is detailed in the accompanying appendices.*

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* Information re appendices are available upon request.

-- Mini-train

The cost components of the alternatives were all expressed in annual payments. The cost components of the mini-train alternative include the following:

- power unit
- modified grain cars
- crew wages
- rail maintenance
- transloading facility
- rail right-of-way.

The crew costs considered a two man crew at a wage of $12,500 each per annum.

Rail maintenance costs were estimated as follows:

1) In the case of Area I (Lyleton) the required upgrading estimates* were expressed as an annual rate.

2) An additional $200 per mile of track per annum was also estimated. This was to account for inspection and minimum maintenance.

3) For Area II and Area III and for a sensitivity analysis of Area I the following** were con considered:

   - use of power unit to maintenance
   - annual cost of small maintenance car

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* Provided by CP Rail in a submission to the Grain Handling and Transportation Commission. See Appendix H. The level of upgrading was taken as sufficient to maintain the line for a period of up to ten years. See Page H.5, Point F.3.

** See Appendix I, Table I.9.

- additional wages charged to maintenance

- material costs

- equipment rental

- miscellaneous.

4) The standard maintenance charges were estimated at $1 thousand per track mile per year.

The power unit charges were estimated as follows:

1) cost of capital* was expressed as an annual cost.

2) annual hours of engine operation. This estimate was made considering total grain cars assigned to the line, total volumes handled, length of line and number of trips required.

The costs for the modified grain cars were estimated as follows:

1) cost of capital times the number of cars as annual cost.

2) cost of modification as an annual cost.

3) maintenance chages of $200 per car per year.**

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* All capital is assumed to be spread over 15 years at at 10.0 percent interest rate.

** Maintenance charges for the modified box cars include inspection, standard maintenance (i.e. greasing of bearings, adjustment of flap doors, etc.) and materials.

The rail-to-rail transloading facility costs are detailed in Appendix C.* These included the following:

- capital costs**
- operating costs per year.

The right-of-way costs were estimated as the composite salvage value of the track.***

Table V-5 summarizes the estimated annual costs of operation for the mini-train alternative in general terms.

-- Short Line Alternative

For the short line alternative the cost components were estimated on the following:

- power unit
- box car demurrage
- train crew
- annual rail maintenance
- right-of-way.

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* The Appendices are available upon request.

** Elevating equipment depreciated over 10 years and the rail siding over 15 years. A 10.0 percent interest rate was used.

*** Composite salvage value: the net value of the rail right-of-way considering salvage of steel, land, ties, bridge structures, labour and equipment and transport costs to resale markets. Following discussion with Canadian National Railway and CP Rail an average composite value of $72.50 per ton was estimated. This also represents the total recoverable value of the right-of-way and was set equal to the acquisition costs.

TABLE V-5

OPERATIONAL COST COMPONENTS

-- MINI-TRAIN ALTERNATIVE --

Components	Annual Cost in 1975 Dollars
Power Unit	
Capital	$10,518 times number of units
Operating	$5.45 per hour times number of hours
Crew	$12,500 per annum per person*
Modified Grain Cars	
Capital	$977 times number of units
Maintenance	$200 times number of units
Rail Maintenance	
No Upgrade	$1000 per mile per annum
With Upgrade	Upgrade costs as annual rate plus $200 per mile per annum
Transloading Facility	$65,902 per annum
Rail Right-of-way	Estimated salvage value expressed as an annual cost

* Total crew of two persons in all areas.

The power unit costs were estimated as follows:

1) annual cost of capital

2) annual operating charges based on estimates of grain handled, box cars per train, number of trips and mileage covered.

Box car demurrage charges were estimated as follows:

1) number of box cars required to move the grain volumes was estimated (i.e. total bushels divided by two thousand bushel capacity per car)

2) demurrage charges were estimated at $16 per box car (two days at $8.00 per day).

The train crew wages were estimated at $25 thousand per annum for a crew of two.

The rail maintenance costs per annum were estimated as per the mini-train alternative.

Table V-6 summarizes the cost estimates of the short line alternative as applied to each of the three areas.

-- <u>Trucking Alternative</u>

For the trucking alternative, the cost components were estimated on the following:

- truck transport
- loading/unloading
- road maintenance
- elevator alteration
- transloading facility
- track salvage.

TABLE V-6

OPERATIONAL COST COMPONENTS

-- SHORT LINE ALTERNATIVE --

Components	Annual Cost in 1975 Dollars
Power Unit	
Capital	$10,518 times number of units
Operating	$5.45 per hour times number of hours per annum
Crew	$12,500 per annum per person
Box Car Demurrage	$16.00 per box car
Rail Maintenance	
No Upgrade	$1000 per mile per annum
With Upgrade	Upgrade costs expressed annually plus $200 per mile per annum
Rail Right-of-Way	Estimated Salvage value expressed as an annual rate

The truck transport costs were calculated considering the following:

1) highway loading limitations and thus maximum payload

2) cost of tractor/trailer* as an annual value

3) fleet size requirements

4) total driving time

5) driver wages.

The load/unload costs were estimated on driver wages for downtime. A factor to account for load restrictions of two months at half load was also included.

Road maintenance was estimated as the additional maintenance requirements for the additional truck loadings. This amounted to $300 per mile per year for all highways capable of carrying 74 thousand pounds G.V.W. or less.**

Elevator alterations costs were estimated as follows:

- loading areas capital costs expressed as an annual cost

- annual maintenance of $200 per loading pad per year.

Truck to Rail transloading facility charges are described in

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* Trailer depreciated over seven years at 12.0 percent per annum.

** Canada Grains Council, 'Brandon Area Study'. 1974.

Appendix F.* These charges were expressed on the following:

- site depreciated over 15 years at 10.0 percent
- mechanical equipment depreciated over 10 years at 10.0 percent.

The salvage value of track was also included in the trucking alternative. It represents an income to the rail company and is a trade-off on the overall economics.

The salvage value to the present major rail companies would be relatively high because they have the equipment, labour and markets available to reuse the steel. An independent owner would not have these resources available and would have to make arrangements with a broker, the existing rail lines or an agent involved in the resale of useable materials. The cost of salvage, however, may be prohibitive. To the environmentalist, the salvage value would be negative due to the cost of removing bridges, land restoration, etc. For these reasons salvage is only considered in the trucking alternative and the value acrrues to the major rail companies.

Table V-7 summarizes the cost components for the trucking alternatives as applied to Area I, Area II and Area III.

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* The Appendices are available upon request.

TABLE V-7

OPERATIONAL COST COMPONENTS

-- TRUCKING ALTERNATIVE --

Component	Annual Costs in 1975 Dollars
Truck Transport	
Operational	Utilization cost* times fleet size
Load/Unload	Approximately 18 cents per ton**
Road Maintenance	$300 per mile per annum
Elevator Alteration	
Annual Capital	$660 per annum times number of elevators
Annual Maintenance	$200 per elevator per annum
Transloading Facility	$42,210 per annum
Track Salvage	$72.50 per ton of steel

* Includes payload considerations, trailer costs contingency and load restriction period factor.

* Composite load/unload charge across the three areas

TABLE V-8

OPERATIONAL COST COMPONENTS

-- DO NOTHING ALTERNATIVE --

Component	Annual Costs in 1975 Dollars
Operation	All on-line costs* less current maintenance.
Maintenance	
No Upgrade	$1000 per mile per annum
With Upgrade	Estimated upgrade costs expressed annually plus $200 per mile per annum

* As submitted to the Canadian Transport Commission re: Section 258 of the Railway Act.

-- Do Nothing

Annual costs of the do-nothing alternative were calculated as follows:

1) all on-line costs* less current maintenance per year,

2) upgrading requirements** if required expressed as an annual cost,

3) annual maintenance charges ($200 per track mile for Area I** and $1 thousand per track mile for Area II and Area III***).

Table V-8 summarizes the annual charges for the do nothing alternative as applied to Area I, Area II and Area III.

Summary

1. The evaluation methodology as applied to the four grain handling and transportation alternatives for the three areas was reviewed in this section.

2. The results of the application of the methodology are summarized in the next section.

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* From CP Rail Submission to the Canadian Transport Commission re: Section 258 of the Railway Act. Current maintenance submissions vary greatly from year to year and in many cases are not adequate to maintain the line. These were substituted by estimated charges.(See Table I.9, Appendix I (available upon request))

** For example, upgrading of Area I is required. Appendix H.

*** See Table I.9, Appendix I.

EVALUATION OF ALTERNATIVES

The objective of this section of the study is to summarize the results of applying the evaluation methodology to the four grain handling and transportation alternatives in each of the three areas. Total costs of moving grain to the main line are identified by alternative and compared. A comparison is also made of each alternative operating across the three areas.

Lyleton: Area I

The characteristics of the branch line and the grain handled in Area I have previously been discussed. Table V-9 shows a comparison of the annual costs for each alternative in Area I. The economic analysis considers all costs and benefits that accrue to any agent contributing. The agency paying or benefiting can also be identified. For example, the rail line receives the salvage value of the branch line for the trucking alternative. Additional road maintenance is suffered by the municipality and the elevator alteration costs are incurred by the Grain Companies

The total annual cost for the trucking alternative is $129,577, (column 1, Table V-9). This includes the direct trucking costs for a two truck fleet for 10 months of the year and three trucks during the peak periods. Elevator alterations, additional road maintenance, and transloading facility costs are also shown. The annual value of the rail bed salvage is shown as a system benefit of $40,027. The trucking alternative results in a system cost of 6.67 cents per bushel.

TABLE V-9

COMPARISON OF ANNUAL COSTS

-- AREA I --

	Trucking	Mini-Train	Short Line	Do Nothing
Truck Transport	106,304			
Elevator Cost	8,574			
Road Maintenance	12,510			
Transloading Facility	42,216	65,902		
Rail Maintenance	-	155,778	155,778	155,778
Salvage Value	(40,027)			
Box Cars		23,544		
Power Unit	10,518	10,518	10,518	
Power Unit Operating		4,251	3,270	
Crew		25,000	25,000	
Purchase of Rail Bed (Salvage Value)		40,027	40,027	
Box Car Demurrage			15,560	
On Line Cost*				118,672
Total	129,577	325,020	250,153	274,450
Cents Per Bushel	6.67	16.71	12.86	14.11
Assume average rail maintenance cost of $100/mile Then total cost =	129,577	206,642	131,775	156,072
Cents Per Bushel	6.67	10.62	6.77	8.02

* CP Rail Submission under Section 258 of Railway Act

The mini-train concept is shown in column 2 (Table V-9) at an annual cost of $325,020. This includes the annual cost of 20 modified box cars, the transloading facility, the power unit, and its operating costs, labour and the purchase of the rail bed. The annual cost of the capital investment required to upgrade the existing rail bed is translated to an annual maintenance cost of $155,778. The mini-train alternative results in a system cost of 16.71 cents per bushel.

The short line system costs are outlined in column 3 (Table V-9) and total $250,145 per year. This includes the rail bed maintenance, the power unit and its operation, labour, rail bed salvage and box car demurrage. Transloading facilities and box car modification costs are not required in this alternative. This alternative costs 12.86 cents per bushel.

The Do Nothing alternative, column 4 (Table V-9) costs include rail maintenance and on-line costs. This alternative nets out at $274,450 per annum or 14.11 cents per bushel.

An additional comparison is made at the bottom of Table V-9. These costs reflect the total system costs for each alternative that would be expected if this branch line did not require complete rebuilding. That is, having an annual maintenance cost of $1,000/mile. The system costs for the trucking alternative remain the same at 6.67 cents per bushel, while the mini-train costs are lowered to $206,642 per year (10.62 cents per bushels), the short line is lowered to $131,767 per year (6.77 cents per bushel) and the do nothing to $156,072 (8.02 cents per bushel).

Considering Area I, the following can be concluded:

1) for branch lines of relatively short distance and low volumes, trucking as described herein is a viable alternative to the current system if capital improvements are required to the branch line;

2) if capital improvements are not required, there is little to choose between the trucking and short line concept;

3) the mini-train concept is more expensive because of the capital required for the trans-loading facility and for the modified grain box cars;

4) neglecting the requirement for large capital requirements for rail bed, the short line concept would reduce the current rail subsidies substantially (approximately $140 thousand in Area I)*.

Note that the off-line costs for Area I were not considered as these will be incurred for any of the alternatives.

Cardston: Area II

The characteristics of the branch line and the grain handled in Area II have previously been discussed. Table V-10 shows a comparison of the annual costs of each alternative.

The total annual system costs for the trucking alternative are $279,108, or 8.90 cents per bushel. This includes the direct trucking cost for a six truck fleet operating year round, elevator alteration

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* Including required upgrading subsidy. Current maintenance submissions are not applicable.

TABLE V-10

SUMMARY TABLE

-- AREA III --

	Trucking	Mini-train	Short Line	Do Nothing
Truck Transport Cost	288,830			
Elevator Cost	23,148			
Road Maintenance	17,250			
Transloading Facility	42,216	65,902		
Rail Maintenance		95,000	95,000	95,000
Salvage Value	(99,166)			
Box Cars Cost		35,316		
Box Car Demurrage			25,088	
Power Unit		10,518	10,518	
Power Unit Operating		6,104	6,540	
Crew		25,000	25,000	
Purchase of Rail Bed (Salvage Value)		99,166	99,166	
On-line Cost*				287,906
Total	279,108	323,876	248,182	376,606
Handling cost in cents per bushel	8.90	10.33	7.91	12.01

* CP Rail Submission under Section 258 of Railway Act.

cost, additional road maintenance and the transloading facility cost. The salvage value of the rail bed is considered as a system benefit of $92,336.

The annual cost of the mini-train alternative is shown in column two (Table V-10). It includes the transloading facility, rail maintenance, box car conversion (30 cars), power unit and operating costs, labour and the annual rail bed salvage value. These total $323,876 per year or 10.33 cents per bushel.

The short line costs are summarized in column three (Table V-10) and total $248,182. The cost components are similar to the mini-train alternative except that the transloading facility and box car conversion are not required. However, box car demurrage is included at $25,088 per year. The short line alternative has a total system cost of 7.91 cents per bushel.

The Do Nothing alternative has a net system cost of $376,606 (12.01 cents per bushel) and is shown to be the most costly alternative.

The short line alternative is the least expensive handling system in this area. The total system costs for the trucking alternative are about $30 thousand per year more expensive, considering the salvage value to the rail company.

Considering the parameters of Area II, that is medium grain volumes and medium length of line the following can be concluded:

1) again the need for transloading facilities and grain cars results in a higher cost for the mini-train alternative;

2) the truck to rail transloading facility requirement also mitigates against the trucking alternative; and

3) the short line concept would considerably reduce the annual subsidy requirements by about $120 thousand if standard maintenance charges are considered or about $105 thousand under current maintenance.

Riverhurst - Main Centre: Area III

The branch line characteristics and annual grain volumes for Area III have previously been discussed. Table V-11 summarizes the costs for each alternative.

Column one (Table V-11) indicates that the trucking system has the highest annual cost of any of the four alternatives. This includes the direct trucking costs for a fleet of ten trucks operating one shift per day for ten months and a double shift during the peak months. Also included are elevator alteration costs, additional road maintenance, and transloading facility costs. The rail bed salvage value is considered as a total system benefit. Total system costs for the trucking alternative are $540,498 or 13.82 cents per bushel.

The mini-train costs are identified in column two (Table V-11) and total $366,242. This includes rail bed maintenance, box car conversion (40 cars required), the power unit and its operation, labour and rail bed acquisition costs. This alternative costs 9.37 cents per bushel.

The short line system costs summarized in column three (Table V-11) indicate that this is the least expensive system for this area. It totals $283,442 per year (7.25 cents per bushel) and is over $80 thousand

TABLE V-11

SUMMARY OF ANNUAL COSTS BY ALTERNATIVE

-- AREA III --

	Trucking	Mini-train	Short Line	Do Nothing
Truck Transport Cost	522,395			
Elevator Cost	22,291			
Road Maintenance	44,700			
Transloading Facility	42,216	65,902		
Rail Maintenance		119,000	119,000	119,000
Salvage Value	(91,104)			
Box Car Cost		47,088		
Box Car Demurrage			31,280	
Power Unit		10,518	10,518	
Power Unit Operation		7,630	6,540	
Crew		25,000	25,000	
Purchase of Rail Bed (Salvage Value)		91,104	91,104	
On-line Cost*				370,531
Total	540,498	366,242	283,442	489,531
Handling cost in cents per bushel	13.82	9.37	7.25	12.52

* Canadian National Railway Submission under Section 258 of Railway Act

less than the mini-train concept and over $200 thousand less than the continuance of the present system.

The Do Nothing alternative averages an annual cost of $489,531 or 12.52 cents per bushel.

Considering the parameters of Area III, that is high grain volumes and relatively long branch line length the following can be concluded:

1) in this branch line trucking to a common transloading facility is not an economically viable alternative to the existing system as the existing system is currently costed; and

2) the least costly alternative is the short line concept which in this instance almost halves the annual rail subsidy. That is a subsidy savings of about $200 thousand per annum can be realized under standard maintenance charges or $250 thousand under current maintenance submission.

Area Cost Comparison By Alternative

The objective of this section of the report is to examine the costs of each alternative across the three areas.

-- Mini-train Operational Costs

Table V-12 is a comparison of the mini-train operational costs in the three areas. The costs range from 9.4 cents per bushel in Area III to 16.7 cents per bushel in Area I. In other words as grain volumes increase, the unit costs of movement by mini-train decrease. The capital costs associated with the transloading facility and the grain cars decrease as utilization increases.

TABLE V-12

ANNUAL COST ESTIMATES FOR MINI-TRAIN OPERATION

AREA I, AREA II AND AREA III

(Dollars per Annum)*

Cost Component	Annual Cost in Dollars		
	Area I	Area II	Area III
Power Unit	14,769	16,622	18,148
Modified Cars			
Capital	19,544	29,316	39,088
Maintenance	4,000	6,000	8,000
Crew Wages	25,000	25,000	25,000
Rail Maintenance	155,778	95,000	119,000
Transloading Facility	65,902	65,902	65,902
Right-of-way	40,027	99,166	91,104
Net Annual Costs	325,020	337,006	336,242
Cents Per Bushel	16.7	10.7	9.4

* Source: Appendix I: Area I: Lyleton
Appendix J: Area II: Cardston
Appendix K: Area III: Riverhurst - Main Centre

This source is available upon request

The low operational costs, relatively high box car capacity and flexibility in number of cars result in little impact of distance on per bushel costs over the range examined.

-- Short Line Operational Costs

Table V-13 summarizes the short line operational costs across the three areas. Again as grain volumes increase, the short line unit costs per bushel decrease. A range of 7.3 cents to 12.9 cents per bushel is identified. It is noted, that the cost per bushel is always less than the mini-train because of the need for transloading facilities and modified grain cars for the mini-train alternative.

Again, over the ranges examined, distance has little impact on the per bushel costs.

-- Trucking Operational Costs

Table V-14 summarizes the trucking operational impacts across the three areas. For the trucking alternative, the unit per bushel costs increase as distance increases. The truck is a unit carrier (that is one trailer per tractor) and as such unit per bushel costs increase with distance. The unit costs range from 6.6 cents to 13.8 cents per bushel. It has already been demonstrated (Table V-9) that over short distances truck does compete with rail even when transloading facilities for the truck alternative are required.

-- Do Nothing Operational Costs

Table V-15 summarizes the operational costs of the current system over the three areas. The unit cost per bushel ranges from

TABLE V-13

SHORT LINE ALTERNATIVE ANNUAL COSTS

AREA I, AREA II AND AREA III

(Dollars per Annum)*

Cost Component	Annual Cost in Dollars		
	Area I	Area II	Area III
Power Unit	13,788	17,058	17,058
Box Car Demurrage	15,552	25,088	31,280
Crew Wages	25,000	25,000	25,000
Annual Maintenance	155,778	95,000	119,000
Rail Right-of-way	40,027	99,166	91,104
Net Annual Charges	250,145	261,312	283,442
Cents Per Bushel	12.9	8.3	7.3

* Source: Appendix I: Area I: Lyleton
Appendix II: Area II: Cardston
Appendix III: Area III: Riverhurst - Main Centre

This source is available upon request

TABLE V-14

SUMMARY OF TRUCKING ALTERNATIVE COSTS

AREA I, AREA II and AREA III

(Dollars per Annum)*

Cost Component	Annual Cost in Dollars		
	Area I	Area II	Area III
Trucking Costs	95,921	272,804	500,620
Load/Unload	10,383	16,026	21,775
Elevator Alterations			
Capital	6,574	17,748	17,091
Maintenance	2,000	5,400	5,200
Additional Road Maintenance	12,510	17,250	44,700
Transloading Facility	42,216	42,216	42,216
Rail Salvage	(40,027)	(99,166)	(91,104)
Net Annual Costs	129,577	272,278	540,498
Cents Per Bushel	6.6	8.7	13.8

* Source: Appendix I: Area I: Lyleton
Appendix J: Area II: Cardston
Appendix K: Area III: Riverhurst - Main Centre

This source is available upon request

TABLE V-15

SUMMARY OF ANNUAL COSTS FOR DO NOTHING ALTERNATIVE

AREA I, AREA II AND AREA III

(Dollars per Annum)*

Cost Component	Annual Cost in Dollars		
	Area I	Area II	Area III
Required Capital (for minimum standards)	148,298	--	--
On-Line Operation (less maintenance)	118,672	287,906	370,531
Maintenance ($200 per mile)	7,480	--	--
Maintenance ($1,000 per mile)	--	95,000	119,000
Net Annual Costs	274,450	382,906	489,531
Cents Per Bushel	14.1	12.2	12.5

* Source: Appendix I: Area I: Lyleton
Appendix J: Area II: Cardston
Appendix K: Area III: Riverhurst - Main Centre

This source is available upon request

12.2 cents to 14.1 cents per bushel. These costs are a function of the current major rail company costing formulae.

Summary

1. The annual costs by alternative for each of the three areas were compared in this section and are summarized in Table V-16.

2. Considering the parameters of each area, the following can be concluded:

   - the trucking alternative is viable for short distance low volume branch lines,

   - however, considering that salvage value accrues only to the national rail carriers, the short line is also a viable alternative and this is so because the short line alternative does not require a transloading facility;

   - in areas of medium to high grain volumes and medium to long distances the short line concept is least costly; and

   - in all areas, the short line concept will reduce the annual rail subsidies.

3. Considering the parameters of each grain handling and transportation alternative, the following can be concluded:

   - the trucking alternative costs tend to increase as distance increases as expressed on a per bushel unit basis. The truck is a unit carrier (one trailer) and as such, total per unit costs will increase as distance increases over the range examined.

   - Both the short line and mini-train alternatives exhibit lower unit per bushel costs as volumes increase. Over the range of distances examined, these rail alternatives can increase the size of

TABLE V-16

SUMMARY OF BRANCH LINE COSTS

Costs in Cents Per Bushel

Alternative	Area I	Area I*	Area II	Area III
Mini-train	16.71	10.62	10.75	9.37
Short Line	12.86	6.77	8.34	7.25
Trucking	6.67	6.67	8.69	13.82
Do Nothing	14.11	8.02	12.21	12.52

Total Costs in Thousands of Dollars

Alternative	Area I	Area I*	Area II	Area III
Mini-train	325.0	206.6	337.0	366.2
Short Line	250.1	131.8	261.3	283.4
Trucking	129.6	129.6	272.3	540.5
Do Nothing	274.5	156.1	382.9	489.5

* These system costs reflect a lower annual maintenance cost requirement of $1,000 per mile.

the train. Coupled with the relatively low per hour operational costs, there is little impact of distance on the rail per unit costs.

4. The next section examines the economics of each of the grain handling and transportation alternatives if the grain volumes and right-of-way acquisition costs vary in each area. A sensitivity analysis across each of the three areas is also conducted so that some generalized conclusions as to the "best" alternative can be drawn.

SENSITIVITY ANALYSIS

A detailed cost analysis of the four grain handling and transportation alternatives as these might be applied to each of the three areas has been presented. The objective of this section is to illustrate what happens to the economics of each alternative as the underlying parameters change.

Also, in order to draw conclusions as to overall alternative application, a sensitivity analysis which examines the economics across the three areas is also reported.

The major variables which were examined and are summarized in this section are:*

- grain volumes by area

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* These are also detailed in Appendices I, J and K for Areas I, II and III respectively. These Appendices are available upon request.

- right-of-way acquisition costs, and

- the operational costs over the three areas were compared.

Grain Volume Sensitivity

The operational economics of each of the four alternatives with respect to variations in grain volumes handled was examined. The sensitivity of each of the four alternatives in the three areas considered the following grain volume changes:

- decrease of 40 percent per annum,

- decrease of 20 percent per annum,

- increase of 20 percent per annum, and

- increase of 40 percent per annum.

Figure V-10 illustrates the impact of varying grain volumes on each of the four alternatives in Area I. The following can be concluded:

1) trucking is the least sensitive to changes in grain volumes. However some decreases in unit costs are realized as volumes increase.

2) The rail alternatives (mini-train, short line and do nothing) benefit substantially as grain volumes increase.

3) In the Lyleton area, because of the high capital requirements to maintain the branch line, trucking remains as the least costly alternative.

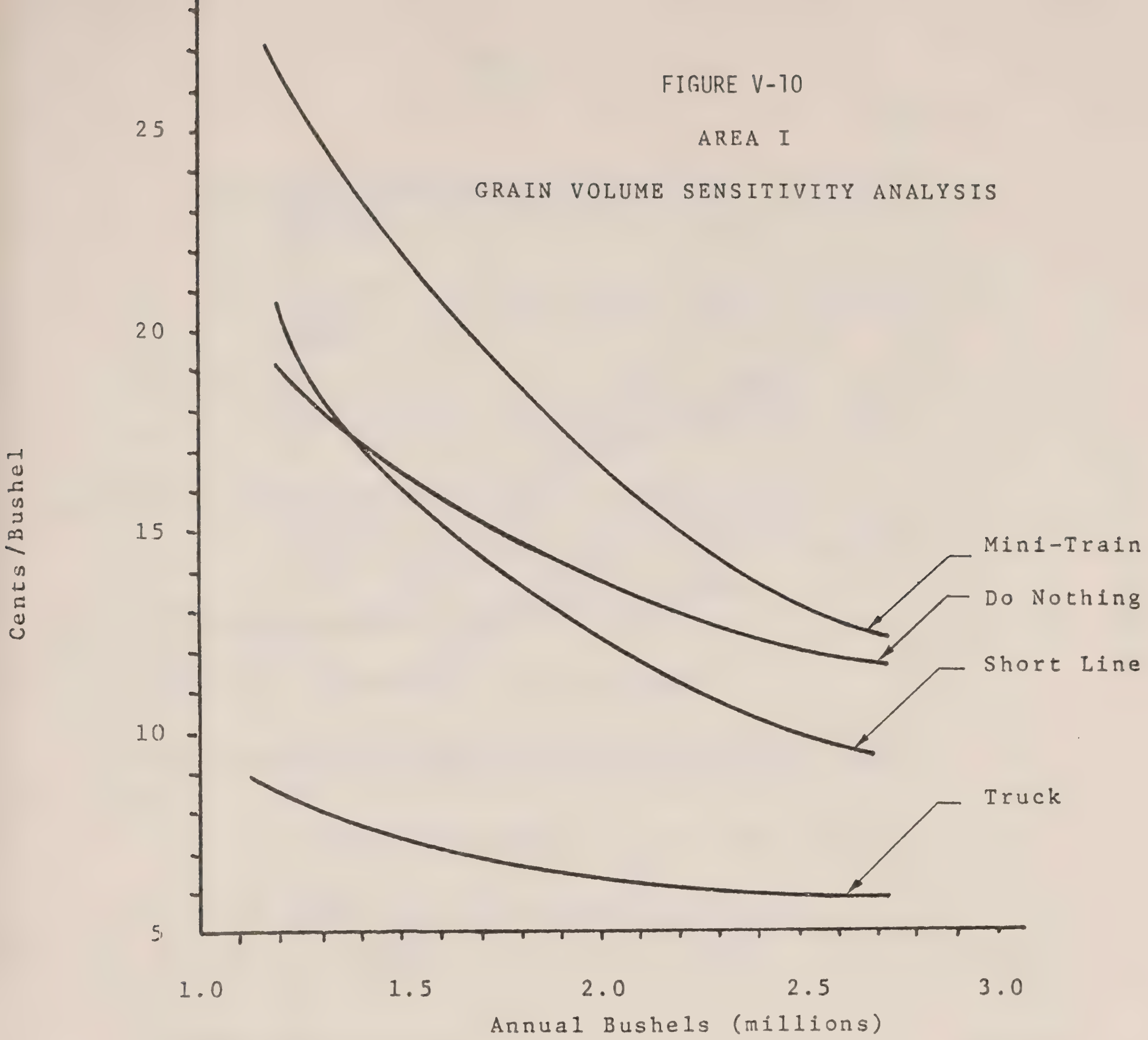
Figure V-11 illustrates the cost sensitivity of the four transport alternatives to changes in grain volume for Area II. The following can be concluded:

1) In Area II trucking is the least costly alternative up to about 3.0 million bushels per year. In other words, for branch lines of low to medium volumes (1.5 million to 3.0 million bushels per annum) and

FIGURE V-10

AREA I

GRAIN VOLUME SENSITIVITY ANALYSIS

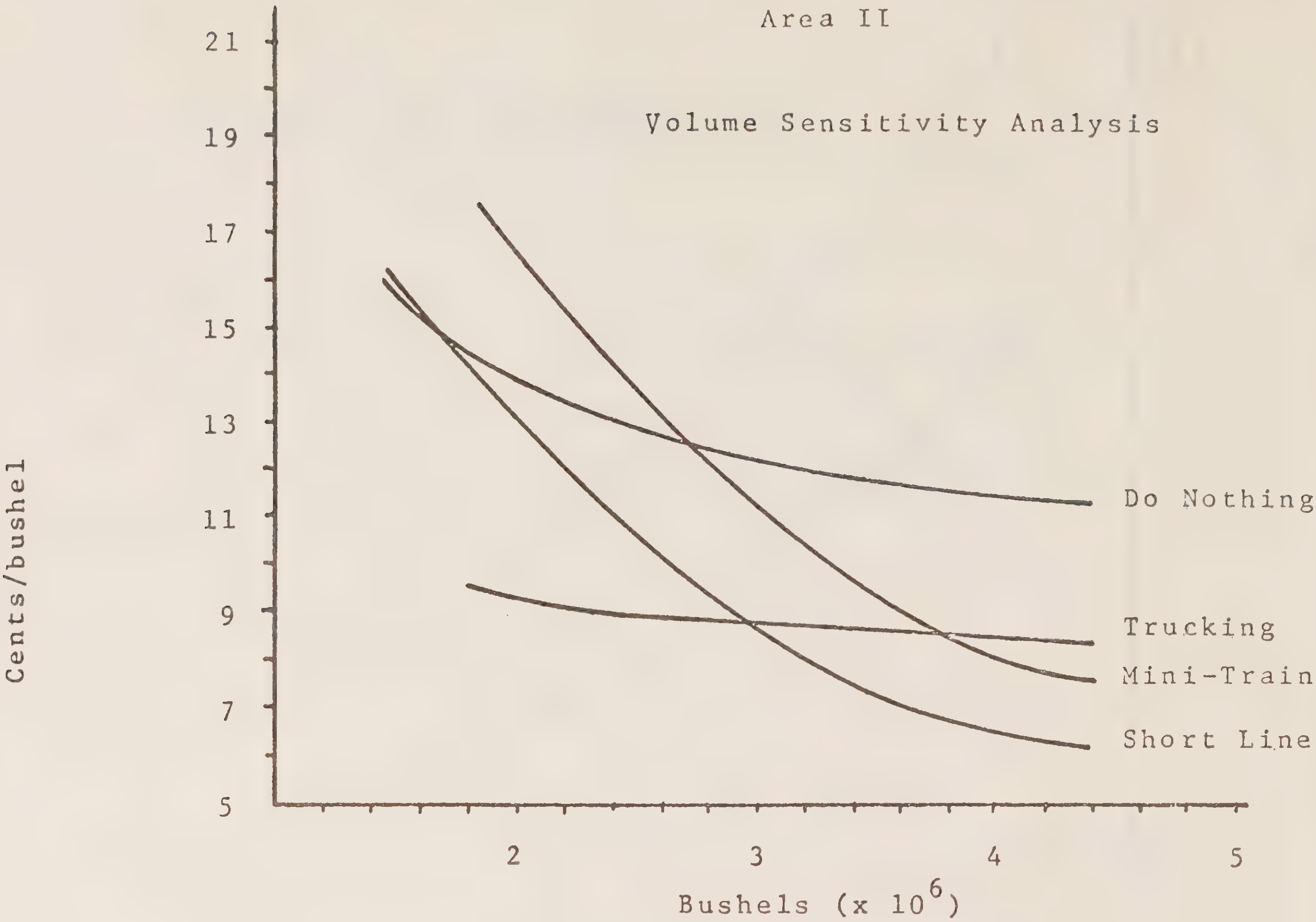


Net Transport Costs in Cents per Bushel

Transport Alternative	-40% (1.17mm bu)	-20% (1.56mm bu)	Actual (1.95mm bu)	+20% (2.33mm bu)	+40% (2.72mm bu)
Trucking	8.95	7.54	6.54	6.19	5.91
Mini-Train	27.33	20.83	16.71	13.96	12.17
Short Line	20.82	15.83	12.86	10.8	9.46
Do Nothing	19.45	16.11	14.11	12.76	11.82

FIGURE V-11

Area II



Net Transport Costs in Cents per Bushel

Transport Alternative	-40.0% (1.88mm bu)	-20.0% (2.51mm bu)	Actual (3.14mm bu)	+20.0% (3.76mm bu)	+40.0 (4.39mm b
Trucking	9.48	8.95	8.90	8.72	8.5
Mini Train	17.36	13.35	10.72	8.96	7.8
Short Line	13.22	10.16	8.34	7.11	6.2
Do Nothing	14.23	12.97	12.21	11.71	11.3

short to medium distances (30 miles to 90 miles) trucking as described in this report is a viable alternative.

2) The short line concept becomes the best alternative as grain volumes increase beyond 3.0 million bushels per year.

3) If volumes exceed about 3.8 million bushels per year, the mini-train concept becomes less costly than the trucking alternative.

4) Over the range of grain volumes examined, the do nothing alternative is the most expensive. However, in the very low range, the do nothing alternative is less costly than the mini-train.

Figure V-12 summarizes the sensitivity analysis of grain volumes for Area III. The following can be concluded:

1) For branch lines of long distance (over 95 miles) and high volumes (over 3.0 million bushels) the short line alternative is the least costly.

2) The mini-train alternative is the second choice in terms of costs over the range of volumes examined.

3) The distances are too great for trucking to be competitive because truck transloading facilities are required.

Right-of-Way Acquisition Costs

A major cost component that emerged in the analysis and applicable to the rail alternatives (short line and mini-train) was the right-of-way acquisition costs. The impacts on the economics of each of the four alternatives were examined for the following:*

1) Amortization of the salvage value of the rail bed over 15 years at 12 percent. Salvage value after 15 years was taken as zero.

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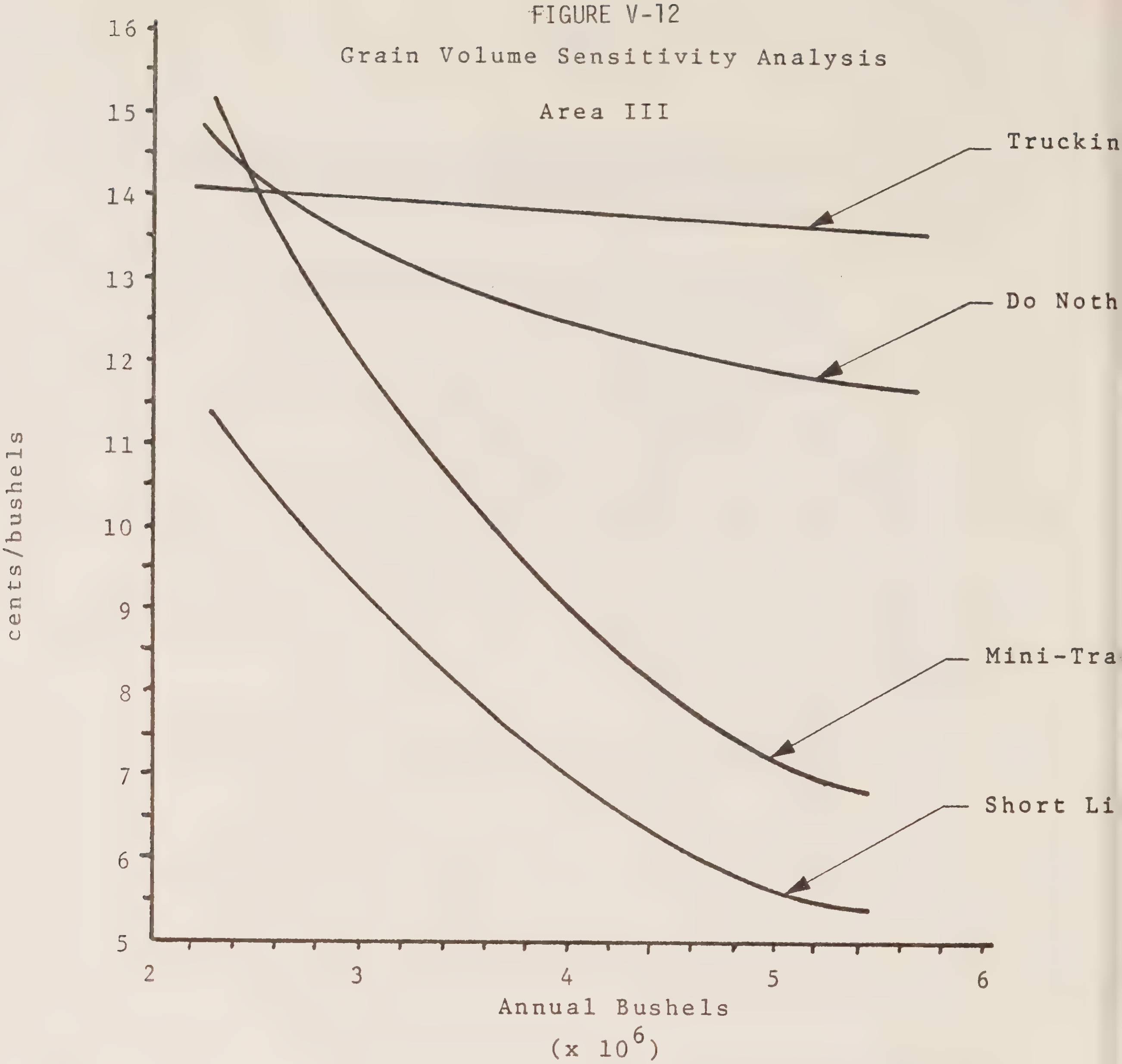
* In the base case, the annual value of the rail bed acquisition was considered to be the interest on the salvage value at 10 percent.

FIGURE V-12

Grain Volume Sensitivity Analysis

Area III



Net Transport Cost in Cents per Bushel					
Transport Alternative	-40.0% (2.35mm bu)	-20.0% (3.13mm bu)	Actual (3.91mm bu)	+20.0% (4.69mm bu)	+40.0% (5.47mm bu)
Trucking	14.13	13.94	13.82	13.75	13.69
Mini-Train	15.08	11.66	9.37	7.84	6.92
Short Line	11.44	8.82	7.25	6.20	5.45
Do Nothing	14.55	13.28	12.52	12.01	11.65

2) Amortization of salvage over 15 years at 10 percent. Salvage value after 15 years is taken as zero.

3) Rental at nil cost per annum and a nil salvage value.

The impacts on the economics of the four alternatives for Area I are shown in Figure V-13*. The following can be concluded:

1) regardless of the railbed costing procedure trucking remains the least costly alternative for Area I if large capital outlays for the railbed are required,

2) under normal conditions (fair to good track condition) for short branch lines and low grain volumes, the short line concept is the least costly up to a rail right-of-way acquisition cost of about $37 thousand per annum or $1 thousand per track mile per year,

3) over this amount, the trucking alternative is the least costly.

Figure V-14 illustrates the cost sensitivity of the four alternatives to rail right-of-way costs for Area II. The following can be concluded: if right-of-way costs are below $110 thousand which is $1 thousand per mile per annum, then the short line concept is the least costly. Above this amount, trucking becomes the least costly alternative for Area II.

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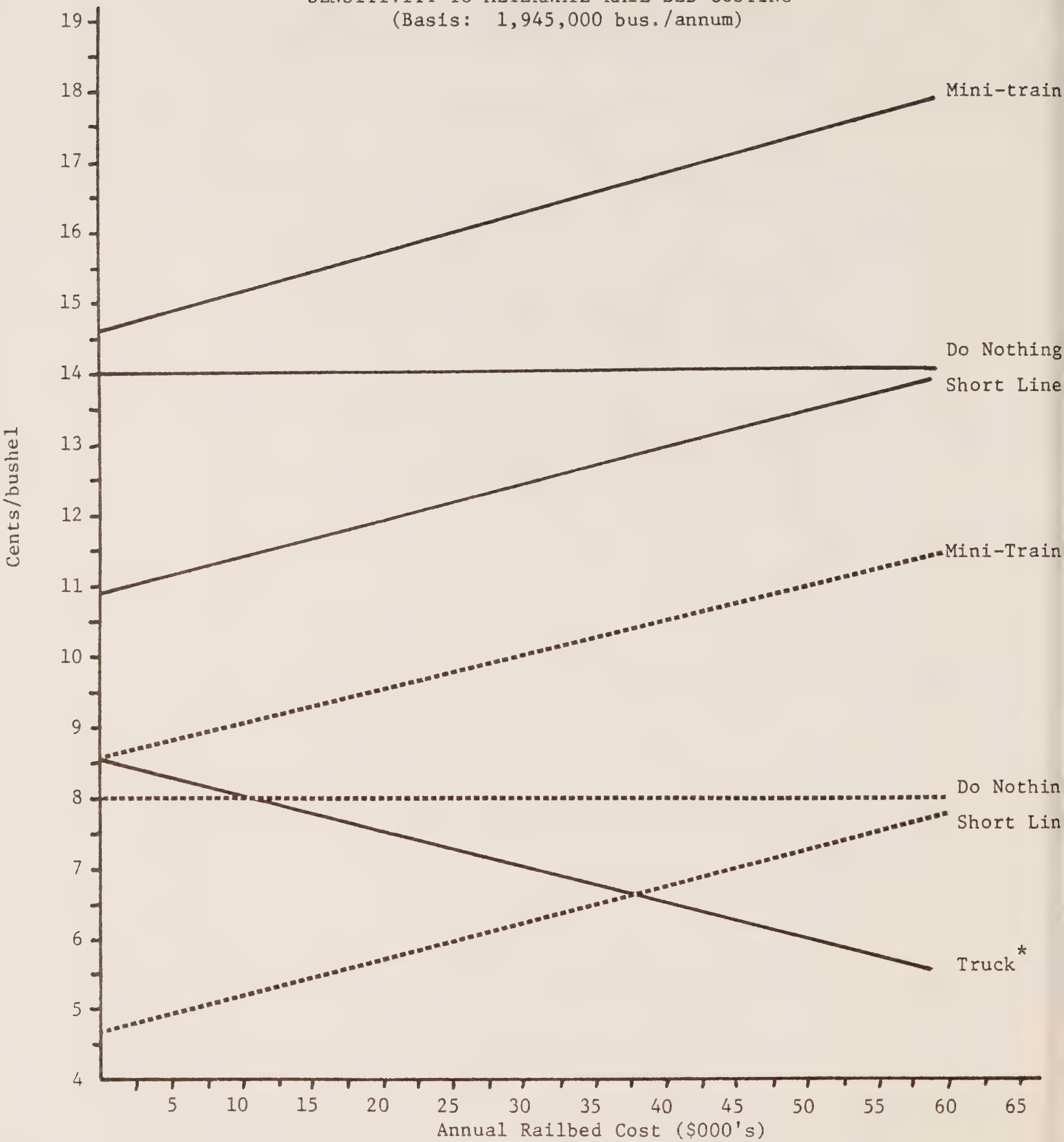
* Although the do nothing costs may vary for various railbed costing the following can be assumed:

- the railway currently owns the railbed and if maintained their investment will be constant in terms of ownership.
- the railways will not be relieved of this obligation over the study period.

FIGURE V-13

AREA I: LYLETON

SENSITIVITY TO ALTERNATE RAIL BED COSTING
(Basis: 1,945,000 bus./annum)



.... Maintenance Calculation at $1,000/yr.

——— Maintenance as per Railway submission to Hall Commission

*Handling costs for Trucking alter native are independent of require maintenance costs for other alternatives

FIGURE V-14

AREA II: CARDSTON

Sensitivity Analysis to Alternative Railbed Costing

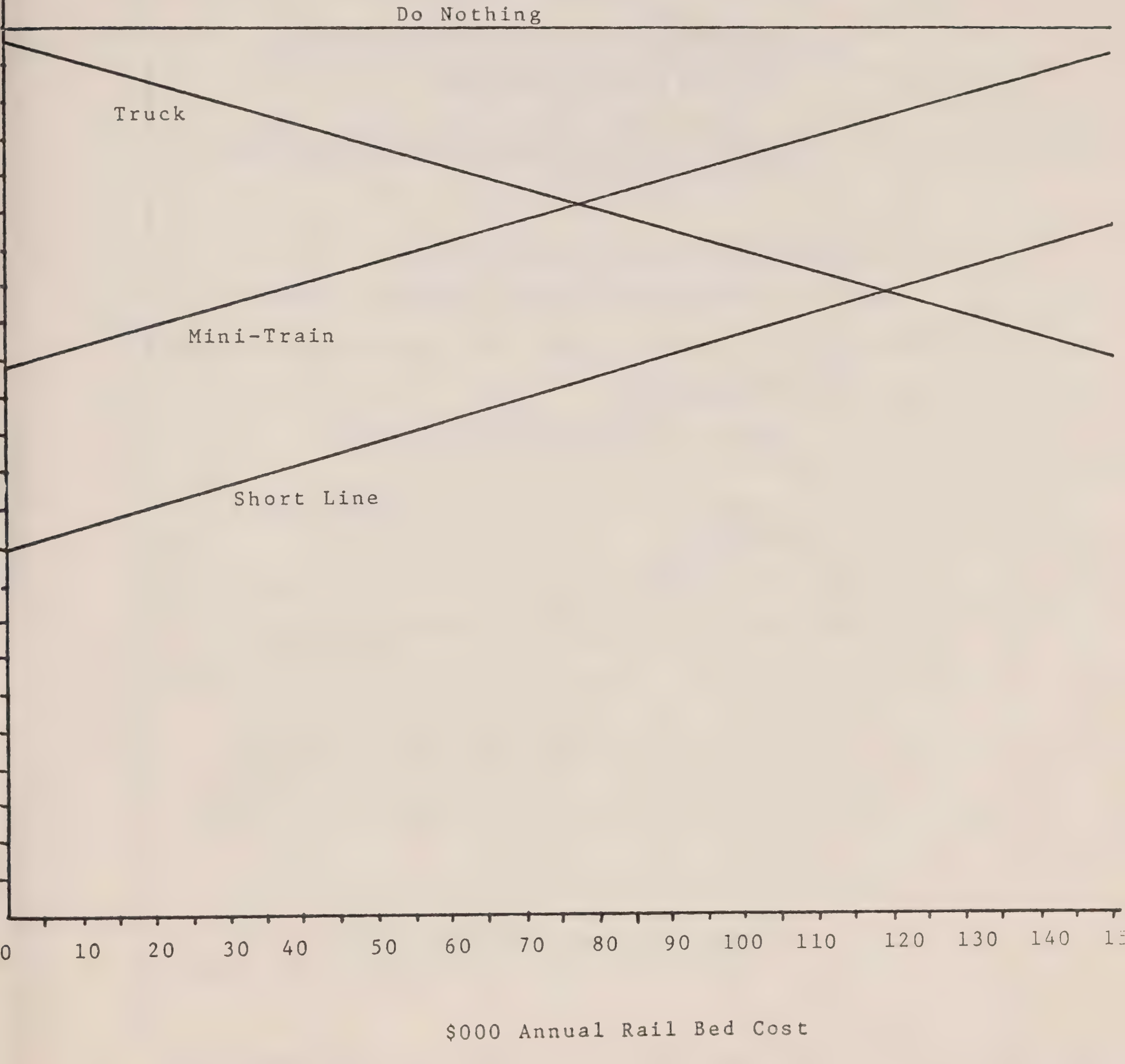


Figure V-15 illustrates the right-of-way acquisition cost sensitivity for Area III. The following can be concluded:

1) For areas of long distance and high volumes, the short line concept is the least costly for reasonable costs of acquisition,

2) Trucking to common transloading point is not a viable alternative under any reasonable railbed acquisition cost.

Operational Cost Comparison of the Three Areas

The overall economics of the four alternatives operating on typical branch lines is shown in Figure V-16. These economics are based on the following assumptions:

- composite salvage value of $10 thousand per mile*,

- average rail maintenance of $1 thousand per annum.

A number of conclusions can be deducted from the graph relative to the application of the grain handling and transportation alternatives on various branch lines. These are as follows:

1) Trucking from elevator points to transloading facilities is the least costly up to a transport product of about 2.5 million ton-miles per annum. This represents branch lines from 30 to 120 miles in length handling between 3.0 million and 0.8 million bushels respectively.

2) However, the cross hatched lines on the trucking, mini-train and short line curves are indicative of the wide variation that may exist because of varying rail acquisition and rail maintenance values.

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* The salvage value varies according to steel gauge.

FIGURE V-15

Area III

Sensitivity Analysis to Alternate Road Bed Costing

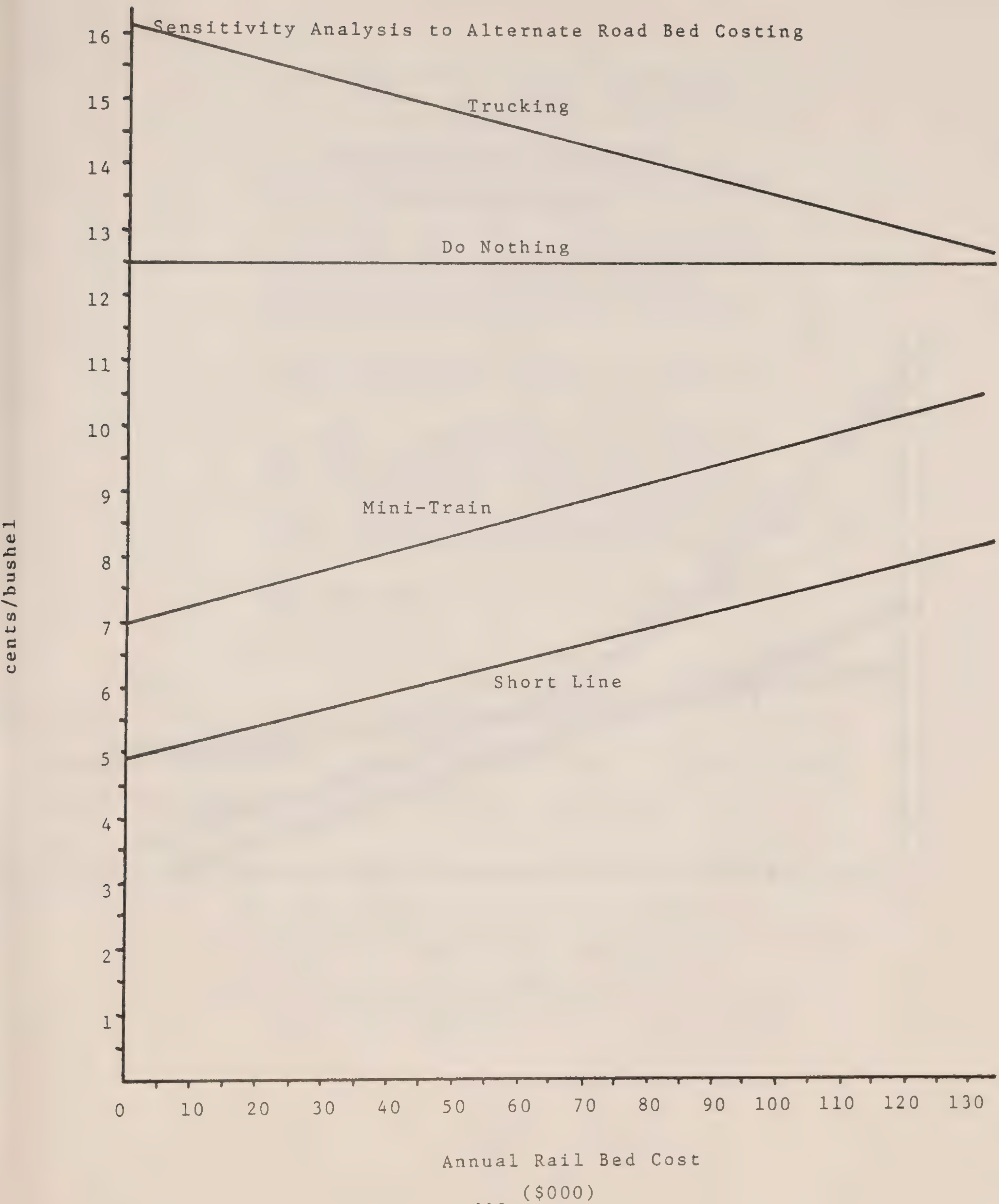
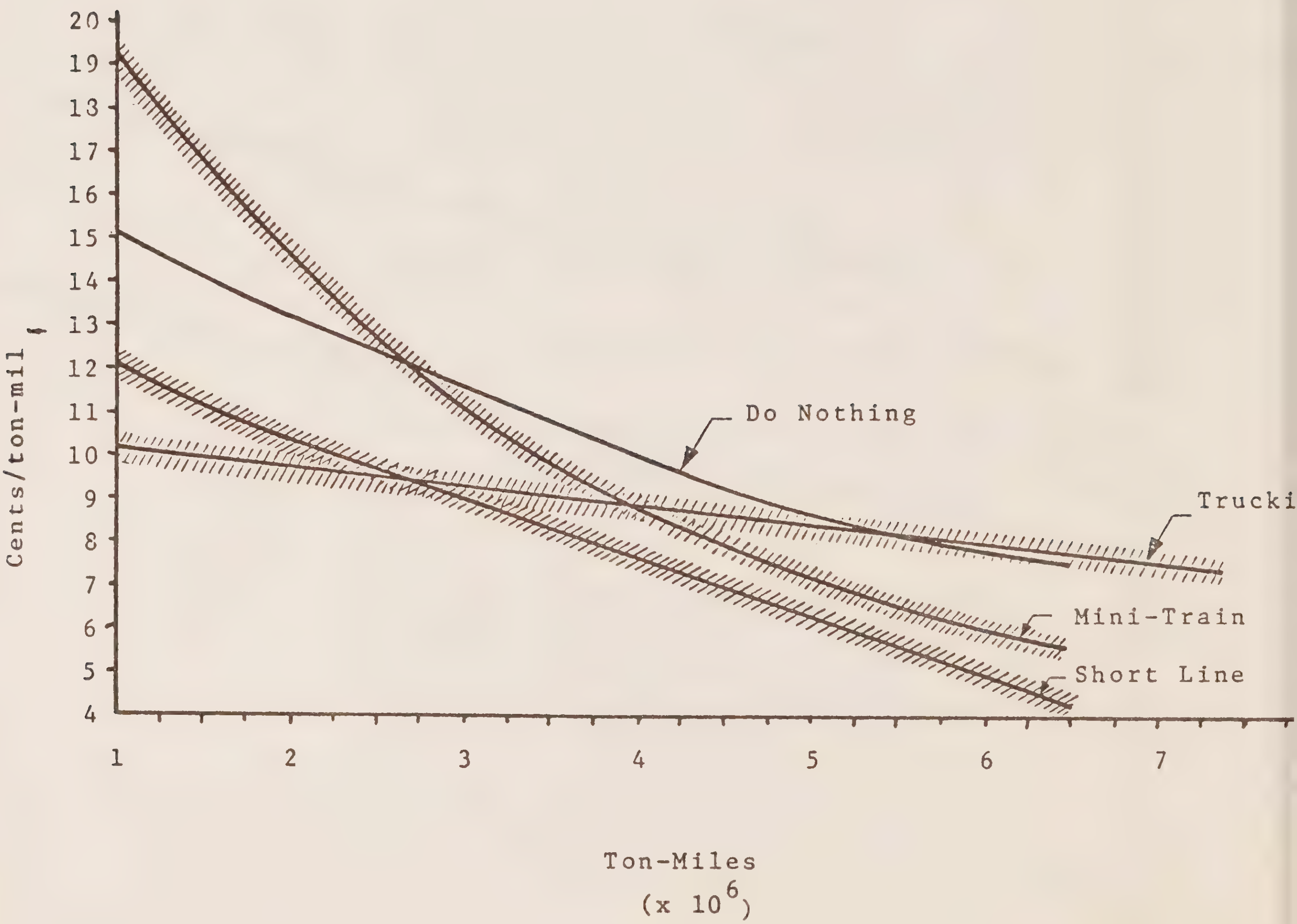


FIGURE V-16

OPERATIONAL COST COMPARISON

OF THE THREE AREAS



3) As the rail acquisition and rail maintenance costs increase, the range over which trucking is a viable alternative also increases.

4) In other words, if the existing trackage is in poor condition, then in all likelihood trucking is the least costly alternative.

5) On the other hand, if grain volumes are moderate to high in an area, the short line concept is applicable if the trackage is in reasonable condition. (Large capital outlays to maintain the track are not required).

6) In all applications the short line concept will reduce the annual subsidy requirements.

7) The need for transloading facilities and grain car conversion negates the desirability of the mini-train concept. In other words, the mini-train cannot compete with the short line because of the additional costs associated with the transloading facility and grain car modification.

8) The least desirable concept in economic terms is the continuation of the current system.

Summary

1. A series of sensitivity analyses were reported in this section. The operational cost variations that would arise due to changes in the underlying parameters were summarized.

2. For changes in grain volumes the following was concluded:

   - for low to medium grain volume on short to medium distance lines trucking is a viable alternative to the current system;

   - as grain volumes increase the short line concept is more attractive.

3. For changes in rail acquisition costs, the following can be concluded:

   - for acquisition costs of less than $1 thousand per mile per annum on short and medium length branch lines with annual grain volumes of 2.0 million bushels the short line concept is the most attractive alternative to the current system.

   - for high volume long distance branch lines, the short line is the least costly alternative for reasonable branch line acquisition costs.

4. The operational costs across the three Areas were examined. The following can be concluded:

   - for branch lines with a low transport product requirement (less than 2.5 million ton-miles per year), trucking is the desirable alternative.

   - for all other areas, the short line provides the best alternative to the current system.

CONCLUSIONS

This study has summarized a detailed analysis of grain handling and transportation alternatives for application to light traffic density branch lines. From the analysis, a number of conclusions can be developed. These are presented in this section of the study.

Technical Feasibility of Mini-Train

1. One of the basic questions to be answered in this study was the technical feasibility of a mini-train operation. The design of

the total system presented in this report is technically feasible.

2. For the mini-train the following was concluded:

   - the most attractive power unit is a used diesel electric switching locomotive,

   - the recommended grain car modifications for the mini-train system are:

     - longitudinal hoppering

     - seven trap doors along the bottom of each side of the box car,

   - the grain car will unload by gravity. It has a capacity of 1,500 bushels. It retains most of its stability,

   - a transloading facility with a capacity of ten thousand bushels per hour was designed.

3. The capital costs of the three components were estimated as follows:

- power unit and accessories	$80,000
- grain car purchase (unit)	$ 5,400
- grain car modification (unit)	$ 2,033
- transloading facility	$210,067

Technical Feasibility: Short Line and Trucking

1. The short line alternative is technically feasible. The capital cost of the power unit and accessories was estimated at $80 thousand.

2. The trucking alternative is technically feasible. The capital costs of this alternative are:

- truck tractor (annual)	\$15,600
- trailer	\$12,000
- elevator modifications (unit)	\$ 5,000
- transloading facility	\$66,575

Grain Handling Implications

1. If the short line concept is to be implemented on a branch line there will be virtually no change in the grain handling aspects.

2. If the mini-train or trucking alternative is implemented, there will be a number of restrictions placed on the grain handling and these are:

    - the modified grain cars (truck trailers) must be delivered to the transloading facility in multiples that equal the capacity of a covered hopper grain car.

    - the grade and type of grain of each unit transloaded to a hoppered grain car must be identical. While this may present no problem from one specific elevator, an appropriate marshalling may be required for a shipment coming from more than one elevator of the same grain company.

    - some grain quality may be lost at the transloading facility.

Labour Implications

1. No insurmountable labour problems are foreseen if a small number of branch lines were to have any of the alternatives imposed on them.

2. The greatest labour difficulty arises when a major rail company abandons a branch line. That is, the possible loss of jobs to the major rail unions due to the closing or transfer of the line to a third party can cause problems. However, if a limited number of lines are closed, personnel would be absorbed into positions on the overall network. Major job loss would only occur if a large number of lines were abandoned.

3. The operation of the transloading facility for the trucking and mini-train systems should be the responsibility of the existing grain companies. This is necessary from a quality control standpoint.

4. The operator of the short line rail, mini-train rail system, and the trucking system should ideally be a small independent company.

5. Effects on the grain grower would relate to the economics (cost per bushel handling and shipping) and to constraints on his ability to ship platform cars. Under all circumstances the grain grower would be able to load platform cars on the main line. However, on the branch line his ability to load platform cars could be impaired by the mini-train and trucking systems and possibly by the short line system depending on the authority of the third party operator.

Areas of Application

1. Considering the alternatives examined, two have possible application and these are the short line and trucking alternatives.

2. In economic terms, the mini-train concept is not a desirable altenrative because of the capital requirements for the modified grain cars and the transloading facility.

3. Trucking is a viable alternative to the current system when branch line grain volumes are low (under 2.0 million bushels per annum) and distances are relatively short (under 50 miles).

4. The short line concept is a viable alternative to the current system when grain volumes exceed 2.0 million annual bushels and distances are over 50 miles.

5. The short line concept reduces annual rail subsidy requirements.

6. Where there is an overlap of the trucking and short line concepts, the appropriate alternative will depend very much on the rail right-of-way acquisition costs, and the physical condition of the line.

CHAPTER 6

COMMERCIAL TRUCKING COSTS AND FEATURES

W.A. Scott

INTRODUCTION

The Grain Handling and Transportation Commission has considered many aspects of the total prairie system in terms of "components" with a view to presentation of alternative configurations in grain assembly. Commercial carriage is one component which could play an important role in grain assembly.

It is helpful to evaluate and quantify this component from the standpoint of the particular enterprise as a business with some emphasis on the entrepreneurial nature of the subject. This requires consideration of profit sensitivity of the particular activity in addition to consideration of cost sensitivity. Examination in this light helps to stimulate ideas regarding a means of assembling components, in order to demonstrate features of various combinations and, thereby, to give one a feel for practical least cost arrangements.

PURPOSE

This report correlates the latest information with existing studies in order to define the features of the commercial trucking enterprise. Costs and rates are analyzed and a methodology is presented for use in compiling the cost of moving grain by this mode as part of a specific area system.

EXECUTIVE SUMMARY

Commercial grain trucking has received relatively superficial consideration in major industry studies to date. The costs of this method of carriage have been analyzed through compilation of existing data in the form of a budget study. This analysis has included an allowance for profit and the results have been validated by cross checking, comparison and reconciliation with other studies and with existing trucking rates. Major findings and conclusions are as follows:

1) Commercial trucking offers a most attractive means of grain carriage in terms of natural gravitation to the lowest common cost denominator through the action of the profit incentive.

2) The intriguing nature of the commercial trucking element, from the cost standpoint, stems, from the high proportion of variable to fixed costs, and the inherent flexiblity and mobility of the business activity.

3) The viability of a commercial trucking enterprise in an area is dependent on sufficient volumes of movement coupled with favourable weather, load limits, road conditions, dispatch and protection from unprofitable competition.

4) Existing commercial trucking loading charges and rates for distances beyond 25 miles are generally reasonable and do allow for adequate profit; however, profits are extremely sensitive to operating time and slight rate changes when expressed in terms of cents per bushe. For example, a typical truck assigned to the movement of 500 thousand bushels over a distance of 40 miles would add $5 thousand per year to profit by an increase of one cent per bushel in the rate. Normal total fleet profit per truck would also likely be in the order of $5 thousand.

5) Rates based on time and mileage costs, as developed by budget analysis, would provide the customer with a more accurate billing for service and would ensure profit level maintenance to the carrier. This method of rate calculation would be especially advantageous in that it:

   a) provides for flexibility in assigning charges to specific hauls to take into consideration different load sizes and truck speeds;

   b) overcomes the inequities associated with existing mileage interval rates;

   c) allows for costs directly related to loading, unloading and waiting time;

   d) has potential to assist both customers and truckers in most efficient utilization as they would become more aware of the real cost components of the operation.

6) The cost of moving grain in an area can be readily estimated by the application of a mileage rate and a time rate which is dependent on truck utilization. These rates computed for 1974, based on single shift operation are $17.15 per hour plus 17.4 cents per running mile.

   Costs of trucking grain in the Lyleton area have been computed as an example:

   - the cost of moving grain by commercial truck from all points on the CP Rail Lyleton subdivision to destination at Deloraine totals $86,392. This works out to an average 4.44 cents per bushel ranging from 2.69 cents per bushel (.245 cents per bushel mile) for grain delivered from Goodland, a distance of 11.0 miles to 6.73 cents per bushel (.161 cents per bushel mile) for grain delivered from Lyleton, a distance of 41.7 miles. These costs include 40 minutes per trip for loading, unloading, checking and tarping as well as an allowance for profit and administration.

7) Cost structure is dependent on total truck utilization, overhead, and operational detail such as amount of waiting time versus driving time. The following listing presents an approximate breakdown for a truck fleet operating in elevator to elevator haul and single shift operation for 1974.

Item	Percent of Total Fleet Income
Wages	28.8
Fuel	10.9
Repairs & Cleaning	9.3
Tires	3.2
Depreciation	12.8
Tarping	0.4
License	5.5
Interest Recovery	6.1
Insurance	0.5
Administration	12.5
Profit	10.0
TOTAL	100.0

Rates per revenue mile on the above basis (not including stationary time expense) equal $1.49 considering an average travel speed of about 35 miles per hour.

8) It is recognized that the movement of grain by large commercial trucks will be less damaging to roads than similar movement by smaller farm trucks. This assumes that the commercial trucker would use discretion with regard to the timing of haul in regard to road conditions.

Further assessment of the cost and practicability of area rationalization to include replacement of either farm trucking or rail movement by commercial trucking would be centered on:

a) traffic patterns and road impact,

b) practical operational problems such as:

- dispatch and truck utilization,
- leakage in transit,
- elevator loading operation and cost,
- elevator unloading operation and marginal handling costs.

9) Existing policy and industry practice with regard to rate establishment would provide for fair minimum and maximum charges given:

a) control over entry of non-profitable (short-run) carriers,

b) the possibility of customer (e.g. elevator company) private carriage.

REVIEW OF MOST RECENT INDUSTRY STUDY - AREA 11

The most recent industry wide study, AREA 11, has lead to the compilation or discussion of all significant attempts to analyze the commercial grain trucking element in Western Canada.*

Rates charged for commercial trucking of grain in different operations through Saskatchewan and Alberta were summarized as indicated in Table VI-1. Curves A through D of Figure VI-1 present this data in form for quick visual reference. These curves are drawn through points representing middle of distance intervals for which rates have been established. This provides a more interesting and accurate description for comparative purposes than do straight line regresstion plots suggested in the Area 11 analysis. It should be

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* Study by Canada Grains Council

TABLE VI-1

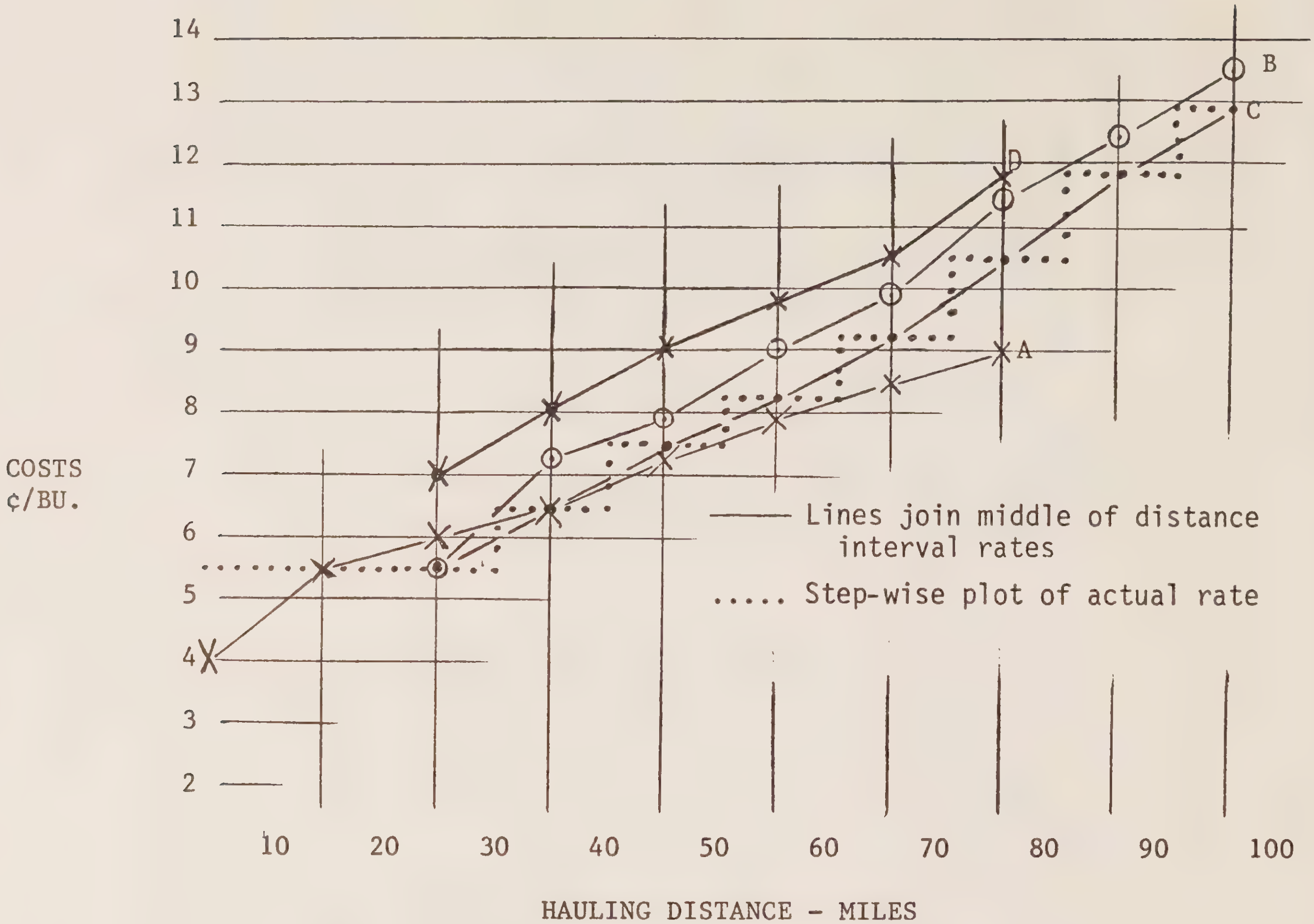
COMMERCIAL TRUCKING RATES CENTS PER BUSHEL
FOR GRAIN LOADED AT ELEVATOR OR PICKED UP ON FARM

MILES	Robin Hood Multifoods - S'toon Elev. & Farm		Sask. Pool Rape Seed 74		Can. Wht. Board S'toon & Moose Jaw 75		Can. Wht. Board Calgary 74	Can. Wht. Board Edmonton 74	Can. Wht. Board Lethbridge 74
	73	74	Elev.	Farm	Elev.	Farm	Elev.	Elev.	Elev.
0 - 10	3.0	4.0							
11 - 20	5.0	5.5							
21 - 30	5.5	6.0	5.6	6.4	5.6	7.8 (7.7)*	7.0	7.6	6.7
31 - 40	6.0	6.5	7.3	8.1	6.4	8.6 (8.5)	8.1	8.7	7.8
41 - 50	6.5	7.2	7.8	8.6	7.3	9.5 (9.6)	9.0	9.5	8.7
51 - 60	7.8	7.8	9.0	9.8	8.1	10.3 (10.7)	9.8	10.4	9.5
61 - 70	8.4	8.4	9.8	10.6	9.2	11.4 (11.8)	10.6	11.2	10.4
71 - 80	9.0	9.0	11.5	12.3	10.6	12.8 (13.2)	11.8	12.3	11.5
81 - 90			12.6	13.4	11.8	14.0 (14.3)			
91 - 100			13.7	14.5	12.9	15.1 (15.4)			

* Numbers in brackets are Saskatchewan Trucking Association rates as of Spring 1975 from brief to Commission, November 26, 1975.

FIGURE: VI-1

COMMERCIAL TRUCKING RATES - 1974



X———X A. Robin Hood Multifoods 1974 rates paid which included some portion of loads from farms.

⊙——⊙ B. 1974 Sask. Pool Rapeseed rates paid not including any allowance for farm loading which would have required addition of 1 to 1½¢/Bu.

.——. *C. 1974 Can. Wht. Board rates to Moose Jaw and S'toon not including any allowance for farm loading which would have been about 2.2¢/bushel extra.

X———X D. 1974 Can. Wht. Board rates--Calgary--about avg. of Calgary, Edmonton, and Lethbridge not including any allowance for farm loading which could be set at up to 2.8¢/Bu. (2 hrs. max.)

*Note: Almost indentical to Sask. Assoc. Brief 1975 Spring rates.

noted, however, that the actual shape of each function is step wise as illustrated by the dotted line running through the points of Curve C.

In addition, a proposal was made in this study, through a cursory analysis of two previous "custom commercial" trucking studies, that "under the degree of rationalization which may prevail in the foreseeable future a cost per bushel mile of 0.22 cents is accepted as a bench mark against which costs derived from other sources can be compared".

A study which was commissioned by the Grains' Group in 1971 titled, "Evaluation of Commercial Carriage of Grain"*, receives passing comments in comparison with commercial trucking studies as follows:

> "The latter study is not directly comparable to the former two in that a budget was used to establish costs -- the latter study while useful for reference purposes is, therefore, not used when attempting to establish actual commercial trucking costs".

The Area 11 study goes on to tabulate cost data which was compiled and combined from a number of commercial trucking firms in Alberta and also the Saskatchewan Trucking Association. The conclusion is drawn that a narrow margin exists between the indicated costs and the rates charged suggesting that there is "keen competition" between firms engaged in the trucking of grain. The information as compiled form this part of the Area 11 discussion is presented in Table VI-2.

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* Study by Trimac.

TABLE VI-2*

INDICATIVE COMMERCIAL TRUCK OPERATING COSTS PER RUNNING MILE IN GRAIN HAULING** PRAIRIE PROVINCES, 1973 AND 1974

Cost Category	Cost Per Running Mile	
	1973	1974
	-----cents-----	
Wages	9.5	13.0
Fringe Benefits including vacation	2.7	3.5
Fuel	7.1	9.2
Maintenance	4.0	5.3
Tires	2.0	3.0
Depreciation	3.9	4.8
Insurance, Taxes, Licenses	3.5	4.3
Overhead and Administration	4.8	5.7
Other	2.4	2.4
TOTAL	39.9	51.2

* This is Tabe XIII from Page 65 of the Area II Study.

** Costs apply to a tractor and 50,000 pound capacity trailer five axle combination unit travelling 120,000 miles per year. The per mile costs indicated refer only to those when travelling. Any loading or unloading costs are in addition to those listed. Costing date is December 1 of the respective years.

QUESTION ARISING FROM REVIEW OF THE AREA 11 STUDY

The Area 11 study failed to illustrate the justification for the final statement regarding costs and rates. It was also noted that the increases indicated from 1973 to 1974 tended to exceed levels one would expect based on statistical indices.

An analysis of the commercial trucking alternative should be carried out separately from that of custom trucking. Considering the vast differences in orientation of the business enterprise it would seem irrelevant to extricate custom trucking costs for use even as a "bench mark".

The Trimac study was reviewed and deemed a serious attempt to analyze the commercial trucking business. It was determined that the running mile costs (as defined for Table VI-2) would account for about 93.4 percent of total costs.* Thus, by applying an additional seven percent to allow for loading and unloading costs and allowing for 10 percent profit (as per Trimac analysis) the total rate per mile for the Area 11 compilation should be 60.9 cents, this is equal to .133 cents per bushel-mile or 2.7 cents per bushel for a 20-mile haul.

Commercial rates acknowledged by the Area 11 study regression analysis, considering a similar elevator to elevator haul situation, range from .241 to .382 cents per bushel mile which is equivalent to 4.8 cents to 7.6 cents per bushel for a 20-mile haul.

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* See Appendix A-1 for supporting calculations.

The Area 11 study conclusion would appear to be contradictory. The typical truck referred to by the Area 11 study would generate 55.08 million* bushel miles. A change by a figure of one in the second decimal place of cost per bushel-mile in cents results in a revenue difference of $5.508 for the typical truck. The difference between a rate of .133 cents and .382 cents per bushel-mile would create a sizeable profit opportunity.

FURTHER ANALYSIS

Several questions regarding commercial trucking activity remain unanswered such as:

1) What would reasonable rates be if an analysis of the business was based on the establishment of a fair rate of return on investment?

2) How do the existing surcharges for farm loading (ranging from zero to five cents per hundredweight) and the "mileage interval" relate to total rates, costs and profit?

3) What costing techniques lead to the most accurate, simple and flexible means of including the commercial trucking element as one component in grain assembly?

4) What are the major operational factors affecting cost and viability of commercial trucking?

In an attempt to provide some insight and develop a methodology for use in area analysis, the above questions will be answered under the following four subheadings.

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* 120 thousand miles ÷ 2 x 918 bushels = 55,080,000 bushel-miles.

Rates

The Trimac study contains sufficient breakdown of costs to provide a background for analysis of commercial trucking rates. In order to assess the "validity of this budget study" as a basis for further analysis it was decided to work gross figures of the Saskatchewan Fleet costs back to running mile costs for comparison with the independently assimilated data of the Area 11 study. The results of this "work-back" are shown in Table VI-3. Area 11 data from Table VI-2 is repeated for comparative purposes. Costs in the 1974 Trimac column have been estimated by the application of indices to update the 1971 data.

Table VI-3 illustrates the effect of utilization on truck unit costs. The Trimac Case II column of the table representing an average truck usage of 106 thousand miles should be the most directly comparable with the 120 thousand mile truck referred to in the Area 11 study summation.

There is good correlation between cost components of the 1974 Trimac Case II column and the 1974 Area 11 study column. Comparative total costs are 56.2 cents per mile and 51.2 cents per mile. The Trimac study budget would appear to be a very reasonable and a somewhat conservative estimate of costs.

It would seem reasonable to carry the discussion a step further by looking at the establishment of rates based on a "return on investment" analysis. The profit per truck of the Trimac Saskatchewan Fleet ranges from $3,470 to $6,700 depending on the truck usage.

TABLE VI-3

COMMERCIAL TRUCK OPERATING COSTS (CENTS)
PER RUNNING MILE IN GRAIN HANDLING

	BASED ON TRIMAC STUDY 1973			BASED ON TRIMAC STUDY 1974			AREA 11 STUDY	
	Case I	Case II	Case III	Case I	Case II	Case III	1973	1974
Wages including Fringe Benefits	13.5	13.5	13.5	18.2	18.2	18.2	12.2	16.5
Fuel	6.2	6.2	6.2	8.6	8.6	8.6	7.1	9.2
Maintenance	5.9	5.5	5.4	7.4	6.9	6.6	4.0	5.3
Tires	2.0	2.0	2.0	2.5	2.5	2.5	2.0	3.0
Depreciation	7.0	4.0	3.2	10.2	5.8	4.4	3.9	4.8
Insurance, Taxes, Licenses	3.9	2.3	1.8	4.8	2.8	2.2	3.5	4.3
Overhead and Administration	7.2	6.2	5.9	9.9	8.5	8.0	4.8	5.7
Other	2.8	1.6	1.2	5.2	2.9	2.2	2.4	2.4
TOTAL	48.5	41.3	39.2	66.8	56.2	52.7	39.9	51.2
INCREASE OVER 1971				(+38%)	(+36%)	(+34%)		

CASE I - Average annual truck mileage 60 thousand.
II - Average annual truck mileage 106 thousand.
III - Average annual truck mileage 139 thousand.

AREA 11 STUDY - Average annual truck mileage 120 thousand

Considered on the basis of an average investment of $17,300 per truck*, this would be 20 to 38 percent return in addition to interest. The tabulated costs included 9.0 percent interest on investment and it is quite possible that the total owner's equity in a commercial trucking enterprise would be in order of one-third to one-half (or less) of the fleet assets.** Normal profits based on costs and rates, as outlined in the Trimac study, could easily be between 40 and 100 percent return on owners' equity before income tax. This would indicate that the allowance of 10 percent of total revenue for profit is adequate for rate establishment.

The updated Case I rate per hour, including loading and unloading time and profit at 10 percent on total revenue, has been applied to several shipping points of the Trimac study. These updated Trimac rate schedule points*** have been plottedin Figure VI-2. The rate schedule as used for Canadian Wheat Board movement of grain to inland terminals at Saskatoon and Moose Jaw is also shown in Figure VI-2, for comparative purposes. Rates derived by updating the Trimac study fall fairly much in line with the rates paid by the Canadian Wheat Board in Saskatchewan movement during 1974; these, of course, are also in line with the Saskatchewan Trucking Association rate.

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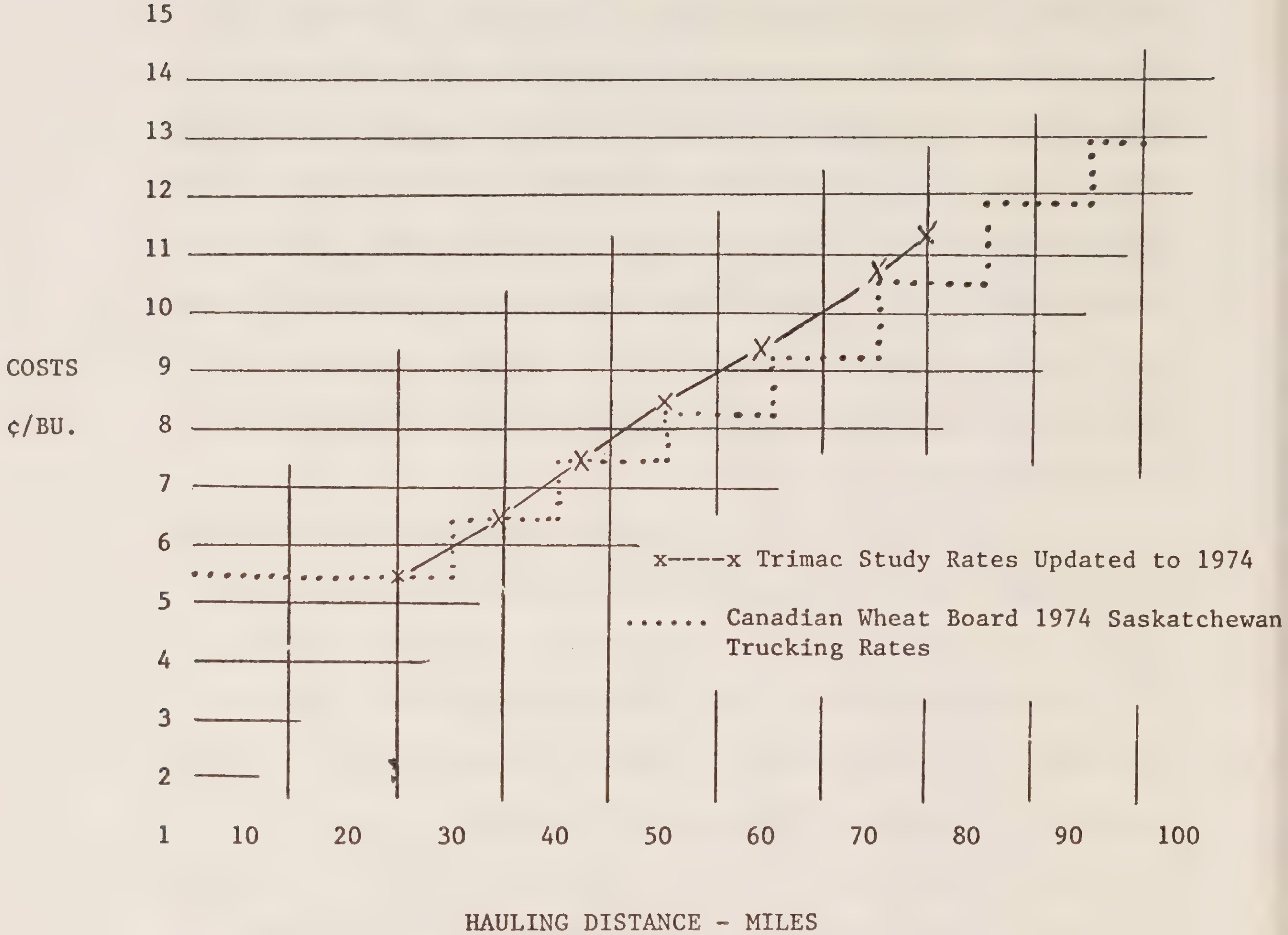
* See Appendix A-5 for calculation.

** See Appendix D for more complete discussion.

** These points plotted for the Case I analysis of the Trimac Study are based on the lowest level of utilization.

FIGURE: VI-2

Comparison of Trimac Study Rates Updated to 1974
and Canadian Wheat Board 1974 Saskatchewan Trucking Rates



The Trimac data includes a substantial allowance for profit from the standpoint of return on investment. An adjustment in this portion of the rate would not significantly alter the total rate figure, but the analysis does show that 1974 rates in the range indicated should allow for some contingencies and should lead to "keen competition"*. The updated Trimac budget will be considered valid for further analysis and development of a costing methodology.

Effect of Loading Charges, "Mileage Interval" Rates, and Slight Rate Changes or Discrepancies

-- Charges for Farm Loading

Farm loading time and charge effects on revenue expenses and profits were looked at by simply picking two different hauling distance points from the Trimac study.** One truck was considered to be operating in each case. Profit per year for the truck was compared in three different operating situations for each of the two hauls. The 1975 Saskatchewan Trucking Association rate of four cents per hundredweight (2.2 cents per bushel) for farm pick up was used in the calculations. The results in terms of profit for one year of one truck's operation are shown in Table VI-4.

Farm loading charges have significant impact on rates and trip or truck profit. The examples demonstrate that an additional 2.2 cents per bushel charge combined with one hour extra

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* Review of actual 1974 profits in trucking grain would indicate a somewhat less positive situation due to factors such as lower utilization and higher average interest and depreciation costs.

** This analysis is based on the low usage Case I column of the 1971 Saskatchewan Fleet Costs.

TABLE VI-4

ILLUSTRATION OF EFFECT OF ONE AND TWO HOUR EXTRA LOADING TIME ON SINGLE TRUCK PROFIT PER YEAR AT THE 1974 RATE OF FOUR CENTS PER HUNDREDWEIGHT FOR FARM PICKUP

Origin of Load	Type of Pickup	TIME ALLOWED FOR IN MINUTES: Primary Elevator Loading	Terminal Elevators Unloading	Tarping and Equipment Checking	Additional Farm Loading	ANNUAL PROFIT* PER TRUCK ($) Based on 1971 Trimac Study Budget Operating Constantly In This Haul
ASQUITH (25 Mi. Haul)	Primary Elevators	20	20	20	Nil	$3,440
	Farm		20	20	80	8,200
			20	20	140	390
KENASTON (49 Mi. Haul)	Primary Elevator	20	20	20	Nil	3,440
	Farm		20	20	80	7,300
			20	20	140	1,770

* Supporting calculations are contained at A-7 of the Appendix. Profit has been calculated by using average truck of fleet expenses as a base, therefore these profit figures are comparative only. It is further demonstrated on Page C-7 of the Appendix to this Report that based on 1974 costs, the four cents per hundredweight charge is reasonable assuming one hour extra loading time.

loading time (80 minutes total) more than doubled the profits*, whereas two hours extra loading time (140 minutes total) resulted in a substantial reduction in profit.

-- Mileage Interval Rates

The "mileage interval" concept can be examined by considering a single truck operating at either extremity of a mileage interval. The average truck of the Trimac study would be subject to a potential annual cost difference of $2,365 depending on whether it was operating at the high or low end of the mileage interval. Considering an average profit for the Case I fleet of $3,470, the interval factor could significantly affect the profit of an average truck. Mileage interval rates at 1974 levels cause discrepancies of approximately one cent per bushel to the customer in the hauls which are greater than 30 miles.

-- The Effect on Slight Rate Changes

It was formerly noted with respect to the average truck considered by the Area 11 study that a slight rate change such as .010 cents per bushel-mile (equivalent to one-quarter cent per bushel for a 25 mile haul) could affect truck revenue by over $5 thousand.

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* This example is merely used to demonstrate the sensitivity of truck profit to loading time and charges. It is further demonstrated on Page C-7 of the Appendix that based on 1974 costs, the 2.2 cents per bushel charge is reasonable assuming one hour extra loading time.

Even though the actual average truck would likely produce less than one-half the revenue miles of the Area 11 truck*, it can be seen that slight rate changes can cause total revenue differences in the same order of magnitude as the normal truck profit.

Costing Techniques and Methodology For Application To A System Rationalization Scenario

It has been established that commercial trucking rates for 1974 are in line with rates as calculated by updating the 1971 Trimac budget. This budget made adequate allowance for profit and it is apparent that slight rate changes have considerable influence on this portion of the total.

Existing methods of "job pricing" within the normal "mileage interval" and loading surcharge rates structure have been used to demonstrate that anomalous results may develop as follows:

1) farm loading charges have a very strong positive or negative influence on the profit margins depending on the time required to load the vehicle;

2) mileage interval rates do not reflect costs for specific hauls; this results in over or under charging with significant effects on profit potential of units operating continuously near the extremities of any given distance interval;

---

* Clayton and Sparks paper presented along with the Saskatchewan Trucking Association brief, entitled, "A Profile of Commercial Grain Trucking in Saskatchewan", considered that a single truck operating between an abandoned line elevator and an on-line elevator 40 miles apart could handle in the order of 500 thousand bushels per year by averaging three round trips per work day, this is equivalent to slightly less than 45 thousand miles per year for a single truck operating 180 days per year.

3) a further shortcoming of a per bushel rate structure is that it does not provide a means of allowing for partial loads or variable traffic speeds.

In order to provide for stable returns and reasonable rates, it would be necessary to charge for farm loading based on the amount of time involved in this part of the operation for each load. A variable rate based on distance of haul and total time would allow for a variety of circumstances. This type of rate establishment would tend to keep rates of commercial trucking in line with costs while ensuring profit level maintenance to the carrier.

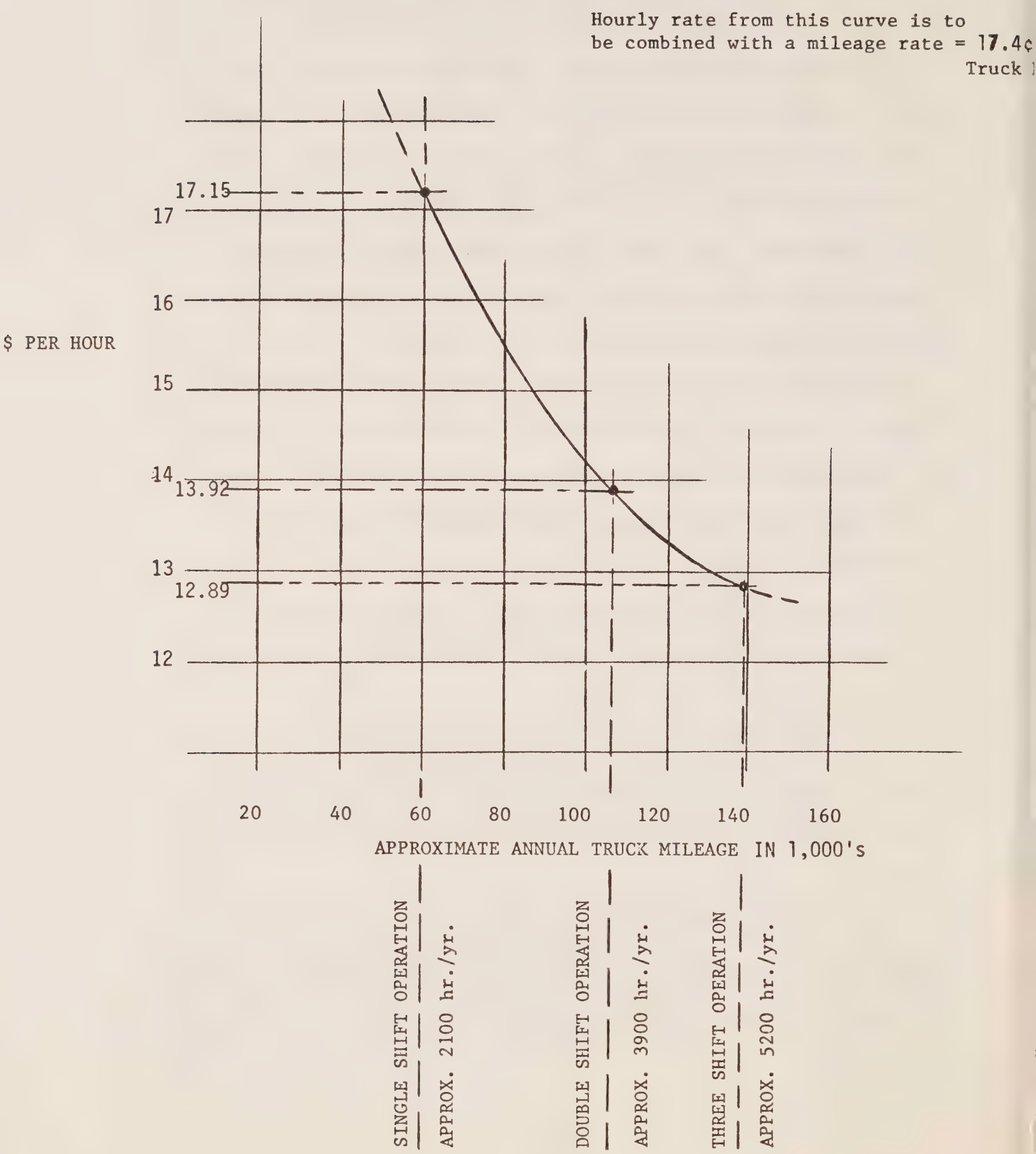
Time related and mileage related costs have been separated and compiled for three different levels of truck utilization as shown in B-1 of the Appendix based on the Trimac data updated to 1974. The results of this compilation have been plotted in Figure VI-3. By reference to the curve of Figure VI-3, an hourly rate can now be obtained for application to a particular trucking situation. The mileage related cost which is applied in conjunction with the hourly rate will not vary with utilization.

Time and mileage based rates offer the optimum in flexibility for use in the analysis of trucking costs. This method of rate establishment is compared with the time related rate determination of the Trimac Study in Appendix B.

A step by step outline of the methodology to be used in the application of time and mileage rates is contained in Appendix C. Included is a data table which has been completed for commercial trucking in the

FIGURE VI-3 TIME RATE VERSUS TRUCK UTILIZATION

BASED ON TRIMAC BUDGET UPDATED TO 1974



Lyleton area of the PMLP Mini-Train Study.* The costs of trucking have been recalculated by the application of time and mileage rates. Comments regarding the comparative results using this methodology versus the original Mini-Train Study methodology follow the Appendix C cost analysis.

The comparative analysis of Appendices B and C generally attest to the reasonableness of the time and mileage rates of Figure VI-3. These analyses also demonstrate the utility of a methodology which uses separate time and mileage components in cost determination.

Major Operational Factors Affecting the Cost and Viability of Commercial Trucking

It should be recognized that commercial trucking profits may be quite sensitive to certain factors on the negative side. The degree of management expertise and the predictability of variables such as the following will determine stability of the enterprise:

1) Weekly variance in grain volume affecting utilization and over-time;
2) Road restrictions and weather conditions;
3) The nature and stability of competition;
4) Dispatch complexity;
5) Legal constraints and public and customer acceptance;

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* A Feasibility Study -- Mini-Train Operation with Transloading Facilities, a report prepared for the Grain Handling and Transportation Commission by PMLP Consultants.

** This development of rates based on time and mileage may be somewhat over-simplified due to such factors as inclusion of depreciation in the budget as a strictly time related item.

6) Rapid or unrecognized cost increases;

7) Rate controls.

The foregoing discussion has intimated the establishment of rates based on trucking costs. This is not an unreasonable notion, however, the converse is not the case and rates do not likely determine cost. Rates will likely be based upon competition from other modes and from private carriage and upon the supply and demand of trucking services. The commercial trucker may, therefore, through skillful management have the means of overcoming shortfall due to periods of low revenue or high costs. For example, during times when higher volumes of business are available, an increase in truck utilization can have a strong positive influence on profit. The final sheets of Appendix C illustrate the usefulness to a trucker of studying the relationship between total cost and various components of cost. The example presented shows that return on investment might be increased by a factor of from two to five times through higher utilization of vehicles.

Cost analysis as presented in this report is based on the use of five axle semis. A recent announcement by the Saskatchewan Minister of Municipal Affairs projects the enforcement of load limits which are not compatible with the use of these larger trucks. Appendix Table VI-D.1 outlines existing highway load limits and the new proposed municipal restrictions.

Appendix D contains excerpts from other studies relating to financial structure and regulation in the trucking industry.

FUTURE WORK

This study has dealt almost strictly with costs and rates; further research and discussion may be justified with respect to:

1) Road impact and traffic safety;

2) Legal constraints;

3) Practical operational problems such as differences between loaded weights at primary elevators and the unloaded weights recorded at the terminals.*

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* In the report of the 1972 Canadian Wheat Board experiments in the movement of barley to inland terminals, it was noted that in more than 30 percent of the cases the difference in weights (averages and shortages exceeded the agreed tolerance of three bushels per truck load).

APPENDIX A

BUDGET BREAKDOWN, UPDATING AND ANALYSIS OF RATE EFFECTS

RUNNING MILE COSTS AS A PERCENTAGE OF TOTAL COSTS - DERIVED FROM TRIMAC STUDY

Sask. Fleet Costs - Case I - 51 Units

Gross Revenue	$ 1,769,260
Less Profit	176,930
TOTAL	$ 1,592,330

Loading and Unloading Costs

33,499 Trips x .667 hrs./trip x $4.69/hr=	$ 104,793
Therefore total running mile costs	$ 1,487,537

Running Mile Costs as a Percentage of Total Costs

$$\frac{1,487,537}{1,592,330} = \ldots\ldots\ldots\ldots \quad 93.4\%$$

Area 11 Analysis Running Mile Cost .... 51.2¢

Rate Based on Above and 10% Profit Allowance .... $\dfrac{51.2¢ \times \frac{100}{93.4}}{0.9} = 60.9¢/\text{Mi.}$

Cost Per Bushel Mile .... $\dfrac{60.9¢}{918 \text{ bu.} \times \underline{2}} = .133¢/\text{bu.mi.}$

(Note: Factor of 2 allows for equal cost and mileage running empty)

Cost Per Bushel For 20 Mile Haul .... .133 x 20 = 2.66¢/bu.

Costs Per Running Mile - Derived From Trimac Study for 1971
Saskatchewan Fleet Costs

	$/Mi.			¢/Mi. 51 Units Case I 60,056 mi/tr	29 Units Case II 105,617 mi/tr	22 Units Case III 139,223 mi/tr
WAGES:	517,500 - 104,793 / 3,062,903 mi.			13.5	13.5	13.5
FUEL:	189,900			6.2	6.2	6.2
MAINTENANCE: (Repairs & Cleaning)	123,650	123,650	123,650			
	13,260	7,540	5,720			
	30,910	30,910	30,910			
	13,260	7,540	5,720			
	181,080	169,640	166,000	5.9	5.5	5.4
TIRES:	38,640					
	23,190					
	61,830			2.0	2.0	2.0
DEPRECIATION:	160,140	91,060	69,080			
	54,570	31,030	23,540			
	214,710	122,090	96,620	7.0	4.0	3.2
INSURANCE TAXES	112,200	63,800	48,400			
LICENCE	7,250	6,240	5,920			
	119,450	70,040	54,320	3.9	2.3	1.8
O.H. & ADMINISTRATION:	221,160	190,370	180,580	7.2	6.2	5.9
OTHERS: (Tarping	7,650	4,350	3,300			
Interest)	79,050	44,950	34,100			
	86,700	49,300	37,400	2.8	1.6	1.2
TOTAL:				48.5	41.3	39.2
Check Total						
Plus Waiting	104,793	104,793	104,793			
Plus Profit	176,930	152,300	144,460			
	1,769,260	1,522,790	1,448,610			

Updated (1971 to 1974) Costs for Case I of Trimac Saskatchewan Fleet

Index	ITEM		UPDATING 1971	1974
	Tractor			
1.45	Depr.		160,140	232,203
1.20	Lic.		112,200	134,640
1.39	Fuel		189,900	263,958
1.25	Rep.		123,650	154,562
1.25	Clean		13,260	16,575
1.25	Tires		38,640	48,300
			637,790	818,000
	Trailer			
1.45	Depr.		54,570	79,126
	Lic.			
1.25	Rep.		30,910	38,637
1.25	Clean		13,260	16,575
1.25	Tarp.		7,650	9,562
1.25	Tires		23,190	28,987
			129,580	172,900
			767,370	1,023,180
1.35	Wage		517,500	698,625
1.3 x 1.45	Int.		79,050	149,000
			1,363,920	1,870,805
1.50	Ins.		7,300	10,950
	Admin.	12.5%	221,160	303,510
	Prof.	10.0%	176,930	242,810
			1,769,260	2,428,070

NOTE: 1974 column is conservative (i.e. may be high). For example the following are compared with costs from Commission Mini-Train Study - late 1975 costs.

	Trimac Updated Cost 1974	Mini-Train Study Cost
Trailer	8,500 x 1.45 = $12,325	$12,000
Labour	4.69 x 1.35 = $6.33/Hr.	$6.50/Hr.

Costs per Running Mile - Derived From Trimac Study
Saskatchewan Fleet Costs Updated to 1974

	$/Mi.			¢/Mi. 51 Units Case I 60,056 mi/tr	29 Units Case II 105,617 mi/tr	22 Units Case III 139,223 mi/tr
WAGES:	698,625 - 141,470 / 3,062,903 mi.			18.2	18.2	18.2
FUEL:	263,958			8.6	8.6	8.6
MAINTENANCE: (Repairs & Cleaning)	154,562	154,562	154,562			
	16,575	9,425	7,150			
	38,637	38,637	38,133			
	16,575	9,425	7,150			
	226,349	212,049	202,995	7.4	6.9	6.6
TIRES:	48,300					
	28,987					
	77,287			2.5	2.5	2.5
DEPRECIATION:						
	232,203	132,037	100,166			
	79,126	44,993	34,133			
	311,329	177,030	134,299	10.2	5.8	4.4
INSURANCE	10,950	9,450	9,000			
TAXES						
LICENCE	134,640	76,560	58,080			
	145,590	86,010	67,080	4.8	2.8	2.2
O.H. & ADMINISTRATION:	303,510	258,890	244,700	9.9	8.5	8.0
OTHERS: (Tarping & Interest)	9,562	5,437	4,125			
	149,000	84,730	64,270			
	158,562	90,167	68,405	5.2	2.9	2.2
				66.8	56.2	52.7
TOTAL:						
Check Total						
Plus Waiting	141,470	141,470	141,470			
Plus Profit	242,810	207,110	195,760			
	2,428,020	2,071,130	1,957,613			

Calculation of Return on Investment for Average Truck of Trimac Study

Tractor cost new		= $18,865
Tractor value old	$18,865 x .20	= $ 3,773
Average investment per tractor of a mixed fleet	$\frac{\$18,865 + \$3,773}{2}$	= $11,319
Trailer cost new		= $ 8,500
Trailer value old	$8,500 x .4	= $ 3,400
Average investment per trailer of a mixed fleet	$\frac{\$8,500 + \$3,400}{2}$	= $ 5,950
Total average investment per unit	$11,319 + $5,950	= $17,269
Investment Recovery	$\frac{1,550}{17,269}$	= 9%
Profit per Truck	Case I = $\frac{176,930}{51}$	= $ 3,470
	Case III= $\frac{144,460}{22}$	= $ 6,570
ROI	Case I = $\frac{3,470}{17,300}$	= 20%
	Case III= $\frac{6,570}{17,300}$	= 38%

Trimac Saskatchewan Rate Schedule
Point - to - Point

At the updated rate of $22.00/hour in place of $16.02/hour*.

To Saskatoon:

From	Miles	Trip Hours	Cost per Trip $	Cost per Bushel ¢
Asquith	25	2.24	49.28	5.4
Borden	34	2.69	59.18	6.4
Radisson	42	3.09	67.98	7.4
Viscount	50	3.49	76.78	8.4
Young	58	3.89	85.58	9.3
Humboldt	70	4.49	98.78	10.8
Hafford	75	4.74	104.28	11.3

Above results used to plot points of Figure VI-2.

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*. $16.02/hr. is rate for 1971 Trimac compilation,
$22.00/hr. is rate for 1974 Trimac compilation = $\frac{\$2,428,020}{110,403 \text{ hrs.}}$

Truck Profit Assuming One Hour and Two Hours Extra Loading Time at a Rate of 2.2¢/Bu. = $20.20/918 Bu.

1. Example - Asquith - 25 mile haul

Normal no. of trips/year/truck	$\frac{2,163}{2.24}$ = 966
Normal Revenue	966 x 35.88 = $34,660
Average Expenses Of Truck in Fleet*	$\frac{1,769,260 \times .90}{51}$ = $31,220
Normal Profit/Truck (Based on ave. expenses of fleet) i.e. Close to average for fleet = $3,470	= $3,440

a) One hour extra loading time

No. of trips	$\frac{2,163}{3.24}$ = 668
Revenue	668 (35.88 + 20.20) = $37,461
Savings as per mile operating expenses (.0620 fuel + .0500 repairs + .0200 tires)	= .1320
Expenses	31,220 - (966 - 668)(50)(.1320) = $29,250
Profit	= $ 8,200

b) Two hour extra loading time

No. of trips	$\frac{2,163}{4.24}$ = 510
Revenue	510 (35.88 + 20.20) = $28,600
Expenses	31,220 - (966 - 510)(50)(1,320) = $28,210
Profit	= $390

---

* More precise figures might be derived by the technique of time and mileage split as illustrated at Page B-4 for use in calculating rates based on this split, however, these figures serve the purpose in illustrating the effect of loading time on truck profit given a standard charge per hundredweight.

2. Example - Kenaston - 49 miles

Normal no. of trips/year/truck	$\frac{2,163}{3.44} = 629$
Normal Revenue	(629 x 55.11) = \$34,660
Average Expenses of Truck in Fleet	$\frac{1,769,260 \times .90}{51} = \$31,220$
Normal Profit/Truck (Based on use of average expenses of fleet)	= \$ 3,440

a) One hour extra loading time

No. of trips	$\frac{2,163}{4.44} = 487$
Revenue	487 (55.11 + 20.20) = \$36,675
Expenses	31,220 - (629 - 487)(98)(.1320) = \$29,383
Profit	= \$ 7,300

b) Two hours extra loading time

No. of trips	$\frac{2,163}{5.44} = 398$
Revenue	398 (55.11 + 20.20) = \$30,000
Expenses	31,220 - (629 - 398)(98)(.1320) = \$28,230
Profit	= \$ 1,770

Effect of "Mileage Interval" Rates on Costs and Profit

Assume rate is constant over a ten mile range.

Costs of a ten mile haul according to Trimac 1971

$$= \frac{10 \text{ mi.}}{40 \text{ mi./hr.}} \times \$16.02/\text{hr.} \times \frac{90}{100} = \$3.60$$

Trucks hauling average of $\frac{33,499}{51} = 657$ trips/year

Possible affect on profit = possible total cost difference low to high end of interval. 657 x 3.60 = $2,365

APPENDIX B

TIME AND MILEAGE RATES DEVELOPMENT
AND COMPARISON WITH
TIME BASED RATE

Time and Mileage Related Rates for 1974 Based on Updated Trimac Study Used to Produce fig. 3

Item	Index	Cost $ Case I (60,000 mi./yr.) Mileage	Time	Case II (106,000 mi./yr.) Mileage	Time	Case III (139,000 mi./yr.) Mileage	Time
Tractor							
Depr.	1.45		232,203		132,037		100,166
Lic.	1.20		134,640		76,560		58,080
Fuel	1.22	263,958		263,958		263,958	
Repairs	1.25	154,562		154,562		154,562	
Cleaning	1.25		16,575		9,425		7,150
Tires	1.25	48,300		48,300		48,300	
Trailer							
Depr.	1.45		79,126		44,993		34,133
Repairs	1.25	38,637		38,637		38,637	
Cleaning	1.25		16,575		9,425		7,150
Tarping	1.25		9,562		5,437		4,125
Tires	1.25	28,987		28,987		28,987	
Wage Burden	1.35		698,625		698,625		698,625
Int. Recovery	1.3 x 1.45		149,000		84,730		64,280
Insurance	1.50		10,950		9,450		9,000
Admin.	12.5%		303,510		258,890		244,700
Profit	10.0%		242,810		207,110		195,760
		534,444	1,893,576	534,444	1,536,686	534,444	1,423,176
		$.164/mi.	$17.15/hr.	$.174/mi.	$13.92/hr.	$.174/mi.	$12.89/hr.

Note: Total Hours = 110,403

Total Miles = 3,062,903

DISCUSSION OF TIME & MILEAGE RATES VERSUS STRICTLY TIME RELATED RATE

The rate schedule of the Trimac study was strictly time related. In the compilation of truck fleet time the loading time was assumed constant at two-thirds of an hour per trip. Actual truck operation under conditions of varying haul distance would result in a proportionately lower hourly cost for shorter distance hauls as the avoidable costs (fuel, repairs and maintenance) would decrease to a greater extent than would the total time per trip, therefore the uniform hourly rate assumption of the Trimac study would not accurately reflect the real variation in trip costs with respect to distance.

The effect of the decreasing avoidable costs with decreasing distance may be shown by application of the time and mileage rates forumla to the shortest and longest haul distances of the Trimac study. Table VI-B.1 displays the results of the application of the time and mileage rates formula to specific points and compares these results with the strictly time related rates of the Trimac study.

Loading and unloading time constituted only about 20 percent of the total time in the Trimac study as all grain was loaded at the elevator. The differences between columns of Table VI-B.1 are therefore not highly significant on a per bushel basis, however, these results do demonstrate the validity of rate establishment related to time and mileage factors.

TABLE VI-B.1

TIME AND MILEAGE RELATED RATES CALCULATION
COMPARED TO TIME BASED RATE CALCULATION

Total Rate Per Trip - $
Case I of Trimac Study 1971

TO: Saskatoon

FROM:	Miles	Trip Hours	Time Based	Time & Mileage Related
Saskatoon	4	1.19	19.06 (2.08)*	15.76 (1.72)
Asquith	25	2.24	35.88 (3.91)	34.30 (3.74)
Hafford	75	4.74	75.93 (8.27)	78.45 (8.55)

* Numbers in brackets are resultant rates in cents per bushel.

TIME AND MILEAGE RATES DEVELOPMENT
FOR USE IN CALCULATIONS PAGE B-5

ITEM	$ COST RELATED TO MILEAGE	TIME
TRACTOR		
Depr.		160,140
Lic.		112,200
Fuel	189,900	
Repairs	123,650	
Cleaning		13,260
Tires	38,640	
TOTAL TRACTOR	352,190	285,600
TRAILER		
Depr.		54,570
Repairs	30,910	
Cleaning		13,260
Tarping		7,650
Tires	23,190	
TOTAL TRAILER	54,100	75,480
TOTAL TRACTOR TRAILER		517,500
WAGE BURDEN		
Int. Recovery		79,050
Ins.		7,250
Admin.		221,160
Profit		176,930
	406,290	1,362,970
TOTAL FOR CHECK		/1,769,26

Total hrs. = 110,403
Total mi. = 3,062,903

Rate/hr. $\frac{1,362,970}{110,403}$ = \$12.3545/hr.

Rate/mi. $\frac{406,290}{3,062,903}$ = \$.1326/mi.

Rate used by Trimac Study;

$\frac{1,769,260}{110,403}$ = \$16.02/hr.

Saskatoon:

4 miles & 1.19 hours = $19.06/trip --(From Trimac Study based on $16.02/hr.)

Rate - (12.3545 x 1.19) + 8 (.1326)--(Time and mileage rate)
= $15.76

Asquith:

25 miles & 2.24 hours = $35.88

Rate - (12.3545 x 2.24) + 50 (.1326)
= $34.30

Hafford:

75 miles & 4.74 hours = $75.93

Rate - (12.3545 x 4.74) + (150) (.1326)
= $78.45

NOTE: above results used to compile table VI-B.1

APPENDIX C

TIME AND MILEAGE RATES

APPLICATION AND COMPARATIVE CHECKING

APPLICATION OF TIME AND MILEAGE RATES

Time and mileage based rates are used in the development of costs for an area as follows:

1) Determine the location, quantities and destination of grain in the area;

2) Define and map the road system which will be used including routing from each location to destination, load limits, mileage and estimate average truck speeds for each portion of road;

3) Considering the restricting load limits for the route, decide on quantity of grain to be moved per trip*, estimate the total loading and unloading, tarping and checking time required per trip and compute the number of trips required.

4) Determine the time required per trip by totalling the time required to traverse each portion of road in both loaded and unloaded direction plus the loading, unloading, tarping and checking time;

5) Add up total route mileage travelled per trip in both loaded and in empty directions;

6) Determine the truck fleet required and the total average mileage and hours of use per unit per year;

7) Considering the utilization figure from the previous step, select the appropriate time rate from the graph Figure VI-3.

8) Apply mileage rate and time rate to the grain movement by multiplying this computed total rate per trip times the number of trips.

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* In the case of different load limits throughout different times of the year, it will be necessary to split the total movements into different trip cost portions in order to allow for varying road restrictions throughout the year. Review the make up of grain quantities in the area and compute the average bushel weight or assume an average figure such as 56 pounds per bushel based on judgement.

COMPARATIVE CHECK ON RATES

One of the areas used in the Mini-Train Study* has been selected and the cost of trucking has been recalculated according to this latest procedure as shown in Table VI-C.1.

The cost as calculated by the application of 1974 time and mileage rates totals $86,392 for the area as compared to the PMLP application of 1975 costs to total $106,304. The difference is accentuated when one considers that the PMLP calculation does not include an allowance for overhead, administration and profit.

The following comparative listing illustrates the higher costs used in the PMLP analysis.

COST - PER REVENUE** MILE

Truck Annual Mileage (Approximately)	Trimac Updated to 1974	PMLP 1975	Area 11 1974
60,000	1.14	1.63	
80,000		1.45	
106,000	95.8		
120,000			.91
139,000	89.4		

* A Feasibility Study -- Mini-Train Operation with Transloading Facilities, a report prepared for the Grain Handling and Transportation Commission by PMLP Consultants.

** Revenue miles are assumed to equal one-half total truck mileage. No allowance is included for overhead and administration and profit in the figures shown.

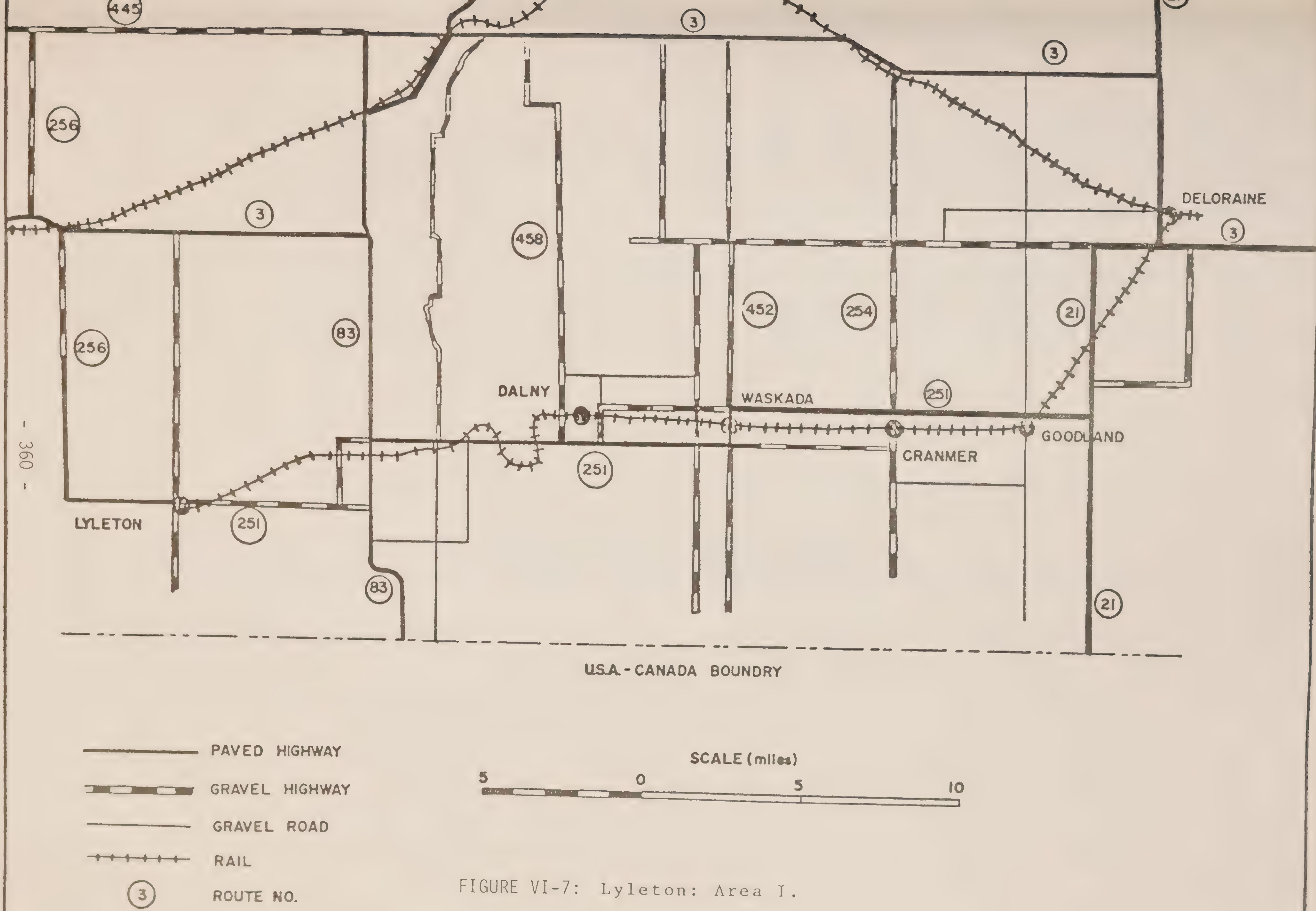

FIGURE VI-7: Lyleton: Area I.

TABLE C-1

LYLETON AREA COMMERCIAL TRUCKING COST

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
LOCATION	DESTINATION	BU./YR.	LOAD LIMIT LBS. GVW	AVG. SPEED MPH	MILES OF ROAD	TOTAL MILES/TRIP	BU./TRIP	NO. OF TRIPS	STAT. HRS./TRIP	DRIVE HRS./TRIP	TOTAL HRS./TRIP	TOTAL HRS./YEAR	NO. OF TRUCK	TRUCK MI./YEAR	RATE $/HR.	RATE $/MI.	TOTAL $/TRIP	TOTAL $/YR.	¢/Bu.	¢/BuMi
Lyleton	Deloraine	500,000	74,000	40	41.7	83.4	918*	545	.667*	2.085	2.752	1,500		45,453	17.15	.174	61.71	33,632	6.7	.161
Dalny	Deloraine	240,000	74,000	40	26.9	53.8	918	262	.667	1.345	2.012	528		14,096	17.15	.174	43.87	11,493	4.8	.178
Waskada	Deloraine	600,000	74,000	40	20.9	41.8	918	654	.667	1.045	1.712	1,119		27,337	17.15	.174	36.63	23,956	4.0	.191
Carnmar	Deloraine	170,000	74,000	40	15.5	31.0	918	186	.667	.775	1.442	268		5,766	17.15	.174	30.12	5,603	3.3	.213
Goodland	Deloraine	435,000	74,000	40	11.0	22.0	918	474	.667	.550	1.217	577	2	10,428	17.15	.174	24.70	11,708	2.7	.245

* This is a weighted average unit capacity from Trimac Study based on 50,000 lbs. net weight.

** This represents an allowance for 20 minutes unloading at elevators combined with 20 minutes tarping and checking time per load.

The annual fixed cost of the Trimac Study tractor and trailer unit (60,000 miles per year Fleet) is approximately $18,000 as compared to approximately $23,000 fixed costs for the PMLP unit. This includes the items defined in the PMLP analysis -- capital, interest, maintenance, tires, licensing and insurance. The difference is accounted for by a 20 percent allowance for contingencies on fixed costs as defined in the PMLP analysis and by the higher costs of leasing versus ownership.

The PMLP variable costs include a further 10 cents per mile to cover lease charges. The Fuel costs for the Trimac Study updated to 1974 are lower. This is partly offset by higher labour per mile figures of the updated Trimac analysis. The PMLP analysis also includes an additional 10 percent contingency allowance on variable costs.

The following compilation of costs shows how the above differences in the cost per revenue mile of the two studies can be reconciled.

	TRIMAC STUDY UPDATED TO 1974	PMLP* 1975
Fixed Costs	$18,000	$23,000 (-$5,000 Referred to in discussion page)
Variable Costs per running mile -- fuel and labour	27¢	29¢
Approximate Cost - excluding administration and profit based on 30,000 revenue miles	---------$1.20**	-----------

* Reference in Appendix D-4 of Mini-Train Study.

** $\frac{\$18,000}{30,000 \text{ mi.}} + (30¢/\text{mi.} \times 2) = \$1.20/\text{mi.}$

Upon review of the above discussion, it would appear that the rates based on the Trimac Study updated to 1974 are reasonable. Even considering the fact that the PMLP data is based on late 1975 costs the resultant revenue-mile rates would appear to be at least 20 percent higher according to the following analysis.

Allow 12½ percent for overhead and administration plus 10 percent for profit on the total fixed plus variable cost of $1.20.

-- i.e. $\frac{1.20}{.775}$ = $1.56 and multiply by 1.12 to update to 1975

-- i.e. 1.56 x 1.12 = $1.75

compared to PMLP cost plus overhead and administration

i.e. $\frac{1.63 \div .775}{1.75} = 120\%$.

The PMLP analysis is high due to allowance for contingencies as well as the higher costs of leasinb but it should be noted* that the 1.12 updating factor inserted in the above calculation also makes the updated Trimac rate more conservative for comparative purposes.

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* See comparative data bottom of page 344.

Reconciliation of Lyleton Area Table C-1 Computed Total, PMLP Computed Total and Cost per Revenue Mile Rates

A. Computed totals -- adjustment and comparison.

Table C-1	Computed Total = \$86,392
PMLP	Computed Total = \$106,304

Adjusted Table C-1 result to allow for lower payload used in PMLP analysis and to update the costs:

$$86{,}392 \times \frac{25.7}{23.3} \times 1.12 = \$106{,}725$$

Adjusted PMLP result to allow for profit and administration and \$1.70 versus \$1.63 rate per revenue mile:

$$\frac{106{,}304 \times \frac{1.63}{1.70}}{.775} = \$131{,}518$$

Ratio of adjusted totals:

$$\frac{131{,}518}{106{,}725} = 1.23$$

NOTE: This is higher than the 120% factor of revenue-mile comparison page C-4 because of the 40 m.p.h. used in cost table C-1 versus the revenue-mile cost derived on average speed of 35 m.p.h. in the Trimac budget.

B. Comparison of costs based on revenue-mile calculation

PMLP Transport Cost Total = \$95,921
based on \$1.70 per revenue
mile and 23.2 ton payload.

Table C-1 Transport Cost Total
based on $1.14 per revenue mile, 25.5 * payload and
103,080 total miles:

$$\frac{103,080}{2} \times 1.14 = \$58,756$$

Adjusted PMLP transport cost to allow for greater payload of Table C-1 analysis:

$$95,921 \times \frac{23.2}{25.7} = \$86,590$$

Ratio of total transport costs calculated on a revenue-mile basis:

$$\frac{86,590}{58,756} = \underline{\underline{1.47}}$$

Ratio of transport costs on a revenue-mile basis:

$$\frac{1.70}{1.14} = \underline{\underline{1.49}}$$

C. Total cost based on revenue mile calculation for comparison with Time and Mileage rates calculated result of table C-1.

Table C-1 computed total = $86,392

Total cost on a revenue-mile basis = transport cost + stationary time + profit & administration.

$$\frac{58,756 + (1414.7 \times 6.33)}{.775} = \$87,369$$

This works out to a slightly higher figure than the table result of $86,392 due to improved efficiency at 40 m.p.h. average speed in table C-1 as compared to budget based $1.14 per revenue mile at an average speed of approximately 35 m.p.h.

---

* PMLP used 55.6 lb./bu. in Lyleton area; for comparative purposes the table C-1 calculation uses payload $\frac{918 \times 55.6}{2,000} = 25.5$ ton.

COMPARATIVE CHECK ON LOADING AND UNLOADING CHARGES

The following tables provide a comparative illustration of loading and unloading charges for elevator and farm hauling by commercial truck.

Considering Elevator to Elevator Haul with 20 minutes loading, 20 minutes unloading including tarping and checking

TRUCK ANNUAL MILEAGE	BASED ON TIME AND MILEAGE RATE THEORY 1974	PMLP 1975
60,000	$\frac{\$17.02 \times .667}{918 \text{ bu.}} = 1.2¢/\text{bu.}$	40 minutes of driver time @ $6.50/hr. and 23.25 tons/load
106,000	$\frac{\$13.80 \times .667}{918 \text{ bu.}} = 1.0¢/\text{bu.}$	is $.18/ton or $.18/36 bu.
139,000	$\frac{\$12.77 \times .667}{918 \text{ bu.}} = 0.9¢/\text{bu.}$	= 0.5¢/bu.

Extra Farm Loading Charges

Based on Time and Mileage Rate Theory and annual truck mileage of 60,000 1974	Industry Charges 1974: Sask. Pool Rape Seed	Industry Charges 1974: Can. Wht. Board Movement S'toon & Moose Jaw	Industry Charges 1974: Alberta Maximum
$\frac{\$17.02 \times 1^*}{918 \text{ bu.}} = 1.9¢/\text{bu.}$	0.8¢/bu.	2.2¢/bu.	2.8¢/bu.

This analysis indicates that the PMLP study which considers only the additional labour (driver waiting time) understates the real loading cost; however the remaining part of this cost is absorbed in the cost per revenue-mile calculation.

The current 2.2¢/bu. charge for farm loading as suggested by the Saskatchewan Trucking Association appears to be in line with rates which would be charged on a time related basis.

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* This allows for one hour additional loading time for a total of one hour and twenty minutes at the farm.

PROBLEM OUTLINE

Assume that the rate for grain haul from elevators on the Lyleton subdivision to Deloraine was based upon normal competition or single shift truck operation whereby total annual revenue available would be $86,392 to move all the grain as computed in Table 1 of page C-4.

Using the typical budgets established for 1974 operation, determine savings (or extra profit) available through double shift operation.

ANALYSIS

Profit for single shift operation = 10% of 86,392 = $ 8,640

On an investment in vehicles of

$$\frac{\text{3991 Hrs. of work}}{\text{2100 Hrs. per turck}} \times \$17{,}300 = \$32{,}880$$

Therefore R.O.I. is .... $\frac{8{,}640}{32{,}880}$ = 26% (plus 9% interest allowed for in budget)

Cost of performing work by double shift = (3991 Hrs. x $13.92/Hr.) + ($.174/Mi. x 103,080 Mi)

Minus profit allowance of 10% = 73,490 - 7,349

= $66,140

Profit for double shift operation at single shift rate:

$86,392 - 66,140 = $20,250

On an investment in one vehicle:

i.e. $\frac{3{,}991}{3{,}990} \times 17{,}300 = \$17{,}300$

Therefore R.O.I. is: $\frac{20{,}250}{17{,}300}$ = 117% (plus 9% interest allowed for in budget)

The effect of operating by employment of overtime would be to reduce the R.O.I. as follows:

Cost of performing work by double shift would increase by:

$$3991 \text{ Hrs.} \times \frac{\$6.33}{2}/\text{Hr.} = \$12,630$$

And R.O.I. would be $\frac{20,250 - 12,630}{17,300}$ = 44% (plus 9% interest allowed for in budget).

<u>NOTE</u>: A more detailed analysis would require consideration of each budget item as it might be affected by second shift (night) or overtime operation. The above analysis, for example, is based on a theoretical budget in which depreciation is time related, therefore, some adjustment of profit figures would be appropriate to allow for extra mileage related depreciation in the case of higher vehicle utilization.

APPENDIX D

HIGHWAY LOAD LIMITS AND INDUSTRY FINANCIAL STRUCTURE AND REGULATION

LOAD LIMITS* - POUNDS

	Primary Highways	Secondary Highways	New Limits on Municipal Roads
** Steering Axle	10,000	10,000	
Single Axle w. Duals	20,000	18,000	
Total for "Single Axle Truck"	30,000	28,000	28,000
Set of Tandem Axles w. Duals	35,000	32,000	
Total for Tandem Truck	45,000	42,000	42,000
Total for Five Axle Semi	80,000	74,000	58,000

* This is an outline of Saskatchewan highway load limits and "new limits" proposed for Municipal roads according to latest information - March, 1977.

** This represents an allowable load of 500 pounds per inch of time width and a 10 inch tire size.

COMMERCIAL TRUCKING - FINANCIAL STRUCTURE - COST STRUCTURE - REGULATION

The following are excerpts from other studies relating to trucking in general. These quotes support statements of the foregoing analysis with respect to investment, cost and enterprise flexibility. Some insight into regulation of the industry is also provided.

From: "The Canadian Trucking Industry: Issue Arising out of Current Information"

Canadian Transport Commission
Economic and Social Analysis Branch
ESAB 75 - 5
April 1975

"The trucking industry differs from other industries in that a relatively small amount of capital is required to initiate operations. Trucking firms' principal assets are vehicles, not inventories. The capital investment required by owners is rather small in proportion to the value of equipment purchased. Many trucking firms finance the acquisition of their required capital assets (i.e. trucks), through loans from various financial institutions. Compared to other modes of transport, the average percentage debt to equity of trucking firms is relatively low. This indicates the degree of leverage in the capital structure of the industry. The other modes (air, water and rail) because of their high initial fixed costs have much higher percentage debt to equity figures. For example, truck transport firms have on the average 41.1 percentage debt to equity compared to rail with 74.1, air with 527.8 and water with 367.2. In comparison with the total for all transportation industries, whose average percentage debt to equity is 127.8,

trucking firms rely to a much greater degree on equity financing.

"Operating ratios (the ratio of operating costs to operating revenues), tended to be lower for smaller trucking firms. This may be due to the fact that smaller firms had lower overhead and administration costs. Operating ratios for the industry varied between 92% and 96%.

"Return on invested capital in trucking varied from a low of 10.6% in 1966 to a high of 12.8% in 1968.

"Current ratios (the ratio of current assets to current liabilities), which give an indication of liquidity, ranged from 1.01 in 1964 to 0.97 in 1969. These ratios were considerably lower than those calculated for other industries; however, the Quebec Tariff Bureau ... made the following comments:

> 'It is often said that a sound financial condition demands a minimum ratio (current) of 2 to 1 for commercial and industrial businesses, since the total of current assets should be twice the amount of current liabilities, while it can be 1 to 1 for public service companies, such as trucking, because they do not have any inventory to sell except supplies for their usage, which are not subject to fluctuations in the selling price; percentage wise, this means that the current assets should equal at least 100% of the current liabilities in the trucking industry.'

"A large proportion of the costs in the Canadian trucking industry is variable. Although the precise proportions of fixed and variable costs have not been determined, and may vary within sectors of the trucking industry, it is expected that the proportion of variable costs to total costs is considerably higher for the trucking industry than for most other transportation industries.

"Trucking enterprises have proportionally lower fixed and higher variable costs than do the railways because the major infrastructure (i.e., the roads and highways) is provided largely at public expense.

Railroads on the other hand must invest considerable capital for roadbed, track construction and maintenance."

From: "Selected Papers on Prairie Transportation"

University of Saskatchewan 1971
Chapter 8
Freight Rate Regulation in Canada

M. Prabhur
Assistant Professor of Law
University of Saskatchewan, Saskatoon

"Truck... cost characteristics are entirely different than railways with small investment and no fixed plant comparable to the railroad permanent way, and a small margin between variable and fixed costs.

"Confinement of their operations principally to short-haul, high rated, small shipments has been necessitated by the peculiar nature of operating costs experienced by the trucking industry; these are only marginally lower than total costs which include cost of the vehicle, cost of licence, etc.

"The small amount of investment required to operate a trucking business has two very significant effects on the industry itself and on its ability to compete with other modes not experiencing similar cost characteristics. In the first place, unlike the railways, the ratio of capital investment to gross revenue in trucking is small, so that there is a very small margin between variable costs, i.e., those costs directly attributable to the movement concerned, and fully allocated costs, with the result that freight classification has really no place in the highway rate structure. In consequence the

prospects of achieving economies of scale are remote. Secondly, almost anyone with a small amount of capital to buy or hire, purchase or lease a truck -- and with physical ability to drive a heavy vehicle, can enter the industry and make a living, unless restrained by regulatory controls, and just as easily fold the business when times are bad and realize a substantial part of the investment if any has been made. These characteristics mark out trucking as a distinct industry epitomizing the classical mode of 'perfect competition'. Trucking has thus remained, in the main, a small scale industry with a very large number of extremely mobile independent organizations each owning a few trucks, each with its own operating characteristics and costs and its own specialized freight traffic and area of operation. It also includes a larger and more diverse group of private carriers which comprises everything from nation-wide corporations down to individuals owning a single vehicle.

"The economic effects of this diversity of the industry are two fold; firstly, the ease of entry results in a tendency for overcapacity to develop and persist, leading to ruinous competition which in turn leads to deterioration in stability of service and safety, evasion of regulation, financial irresponsibility, and even bankruptcy. Secondly, the ability of such an industry to withstand competition from other modes such as the railways and water carriers, is limited in the short run, though in the long run they may be the most economical agency of transport; so that predatory pricing or selective pricing backed by the financial 'leverage' that the stronger modes have, could easily drive the small truckers out of business.

"Although perfect competition assumes this constant exit from and entry by newcomers into it, it places the industry in a state of continuous instability and depresses the rates to such an extent that in the long run higher costs are likely to prevail.

"The principal controls imposed on the trucking industry are those restricting entry and those regulating rates. Entry into common carriage is restricted in all provinces by the requirement of a licence to operate, licence in most cases being granted only on proof of 'public convenience and necessity'. This restriction is designed to prevent overcapacity and it protects established firms to some extent from the evils of cut-throat competition which would otherwise prevail.

"If control of entry into the industry is not sufficiently flexible, competition is restricted and existing firms are in a position to earn more than normal profits, which is detrimental to the interests of the users and the public. The only restraint in such a situation will come from shippers who could substitute their own transport.

"If the private carrier finds it economic to use his own truck to haul his goods, nothing should be done to prevent it, and in fact the right to this alternative is a healthy check upon any probable tendencies of regulated carriers to exploit the user; it would also force regulated carriers to prune costs and achieve efficiency as far as possible and thus make private carriage less attractive to the shipper.

"The MacPherson Commission as an alternative to restricting entry preferred:

> 'Lively and sympathetic highway traffic boards adequately supplied with the necessary data to examine and advise prospective entrants to the commercial trucking industry

> if it appears to the public authorities that there are too many trucking companies and that this situation is chronic.... Concentration upon regulation of operations, with freedom of entry based upon knowledge, will promote the type of atomistic competition which brings adequate resources to bear in the provision of road transport at prices for service related to costs and normal returns to enterprise. Incentives to efficiency and the attendant returns are encouraged without the regulatory boards being responsible for any degree of monopoly profit.
>
> '...under ordinary circumstances the interests of both the industry and the public can better be served by a system of control of minimum rates devised in such a manner, having regard to the latest techniques in cost accounting, that they reflect the most efficient units in the industry, with sufficient flexibility to enable common carriers to determine their rates in any manner they deem necessary to meet competition not only from contract and private carriers but also from other modes of transport. Where necessary, these common carriers should be permitted to reduce their charges to out-of-pocket expenses for any empty back hauls they would have to make, thus making private carriage uneconomical.
>
> 'The device of maximum rate control is unimportant in highway rate regulation because of the inherently competitive nature of the industry and the checks afforded by private trucking.'

"Opinions on the need for controlling rates differ and advocates on both sides can be found. The MacPherson Commission felt that it is better to scrap all rate regulations.

"The Federal Motor Vehicles Act empowers provincially constituted traffic boards to determine or 'regulate the tariffs and tolls to be charged by a federal carrier for extra-provincial transportation in that province .... in the like manner and subject to the like terms and conditions as if the extra-provincial transport in that province were local transport'. The federal Government may exempt any carrier or any part of its operation from provincial control. Where they have been so exempted, Part III of the National Transportation Act may be applied to them. The scheme of regulation is similar to that for railways; the tariff or rates may be filed

with the Canadian Transport Commission directly or through Traffic Bureaus and the Commission may disallow rates if they are non-compensatory or take advantage of a monopoly situation, or prejudice public interest."

CHAPTER 7

TRANSPORTATION RELATED DISTORTIONS IN THE CANADIAN FLOUR MILLING INDUSTRY

T.G. Johnson

EXECUTIVE SUMMARY

The objectives of this study are:

1) to describe the past and current market conditions of the flour milling industries and the likely conditions in the near future;

2) to describe the regional distribution of flour mills in Canada, the probable cause of this distribution and the probable effect of current and future trends on this distribution;

3) to describe the present operating practices of Eastern and Western mills as they relate to the movement of wheat into the mills and to the movement of products from the mills to the market;

4) to estimate the differential impact of a) freight rates, b) subsidies, c) Canadian Wheat Board practices and d) regulations, on Western versus Eastern mills; and

5) to estimate the degree of distortion of locational advantage, if any, created by a) differences and level of freight rates, b) subsidies, c) Canadian Wheat Board practices and d) regulations.

The study employs location theory as a basis for predicting the 'natural' geographic distribution of milling activity in Canada. The actual current distribution situation of the industry is described and compared with that which is predicted by theory.

The operating practices are described in detail so that the mechanics of the various distortions can be appreciated. These distortions are then described and quantified within this operational context.

A measurement of total distortion is estimated for each market for flour and millfeeds as well as the overall average under present markets shares. These distortions are in terms of the difference in

net effective subsidy to Eastern versus Western mills.

It is estimated that under present market shares a Western flour mill receives a net effective subsidy of 10 cents on the average hundredweight of flour (and the resulting by-products) produced. This compares with 59 cents per hundredweight for an Eastern mill. This 49 cents per hundredweight difference represents the average distortion of locational advantage from the West to the East. The export market for flour is only slightly distorted (8 cents per hundredweight in favour of Eastern mills). However, it is possible that Western mills are being excluded from the Eastern domestic market by these distortions since they favour Eastern mills by almost 40 cents per hundredweight.

The analysis indicates that removal of the "at and east" rail freight rates would be extremely damaging to Western mills, increasing the overall distortion from 49 cents per hundredweight to 58 cents per hundredweight, and the distortion in the export market from 8 cents per hundredweight to 45 cents per hundredweight.

The study indicates that the locational characteristics of the industry are very sensitive to transportation related distortions.

INTRODUCTION

The terms of reference of the Grain Handling and Transportation Commission instruct it to consider the implications of possible changes in the system to the region's "economic development opportunities in terms of agricultural processing, manufacturing and natural resource development". One area which has been identified as requiring investigation under this instruction is the effect of the present grain handling and transportation system on the locational advantages of flour mills in Canada and the predicted effect of various changes in the system. The specific objectives of this study are:

1) to describe the past and current market conditions of the flour milling industries and the likely conditions in the near future;

2) to describe the regional distribution of the flour mills in Canada, the probable cause of this distribution and the probable effect of current and future trends on this distribution;

3) to describe the present operating practices of Eastern and Western mills as they relate to the movement of wheat into the mills and to the movement of products from the mills to the market;

4) to estimate the differential impact of a) freight rates, b) subsidies, c) Canadian Wheat Board practices and d) regulations, on Western versus Eastern mills; and

5) to estimate the degree of distortion of locational advantage, if any, created by a) differences and level of freight rates, b) subsidies, c) Canadian Wheat Board practices, and d) regulations.

LOCATION THEORY

In this section, location theory will be discussed very briefly as it applies to this study.

Location theory suggests that industries may be divided into three types depending on the type of location decisions that they make. Industries are said to be input oriented if in the long-run they locate new capacity near the source of inputs (raw products, energy, labour, water, etc.). Similarly, industries are said to be market oriented if new capacity is located near potential markets. The third type of industry is bound to neither input sources nor the market and is called foot-loose.

Location theory implies that there exists some natural advantage in locating a firm in some areas over others. For example, a manufacturing firm located near the market for its product has a locational advantage if:

1) the manufacturing process involves a significant weight increase;

2) the freight rates are higher for the product than for the raw material;

3) the process results in a product which is more difficult to store and/or transport than the raw material; and/or

4) by-products of the process are more profitably disposed of at that location than at another.

If the reverse conditions exist for an industry, then those firms located near the source of raw material will have a locational advantage.

Firms in other industries have natural location advantages if they are located near a cheap or abundant source of inputs (other than raw products). Many industries, for example, must be situated near a source of labour.

Locational advantages are not static, however. A number of factors tend to increase or decrease the locational advantages of an era. Some of these factors include:

1) changes in technology in the manufacturing industry;

2) changes in technology in the transportation industry;

3) changes in the freight structure;

4) changes in market demand;

5) changes in supply of raw materials or inputs;

6) changes in government regulation of the industry; and/or

7) changes in subsidy levels or qualifications.

In the short-run, when capacity cannot be increased, decreased or relocated, changes in the determinants of locational advantage will affect, instead, the profitability of firms. By definition, the effect of these changes will vary with the location of the firms in the industry, improving the profitability of some relative to others.

Location theory also implies that there are 'natural' locational advantages. Any variation from a 'natural' locational advantage is a distortion. Anderson defines a distortion as "....an effect different from that produced by the standard equilibrium model of pure competition with containable allowances for inter-firm deviations from

that model."* Anderson cautions however that in some cases "....the aberrations from the classical model are too large to enable the word 'distortions' to be properly contained...".** In particular "....the transport function in Canada has such long historical ties to the public purse and to agriculture, such deep involvements with public policy, that one is constrained to enquire 'Distortions from what?'".**

Despite the difficulties involved in describing the 'natural' competitive environment of many industries, it is possible and indeed very useful to explore the effects of certain 'distortions' (or groups of 'distortions') on the locational advantage of firms. This then will be the general approach taken in this paper.

AN OVERVIEW OF THE CANADIAN FLOUR MILLING INDUSTRY

In the crop year 1974-75, Canadian flour mills ground 88,889,000 bushels of wheat into 39,020,000 hundredweights of flour (Tables VII - 1 and VII - 2). Of the 39.0 million hundredweights of flour milled, 8.1 million was exported and 30.9 million was used domestically.

As of July, 1975, there were 42 flour mills in Canada (Table VII - 3). This compares to the 101 mills in 1954. A majority of Canadian flour

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* F.W. Anderson, "Grain Movement Subsidies in Canada and Economic Distortions" in Transportation Subsidies--Nature and Extent, ed., Karl M. Ruppenthal, (Vancouver, B.C.: Centre for Transportation Studies, U.B.C., 1974) p. 49.

** Ibid.

TABLE VII-1

Millings of Total Non-Feed Wheat
By Eastern and Western Mills
(1954-55 to 1974-75)

Year	Bushels Milled			% Milled	
	East	West	Total	East	West
1954-55	44,172,101	48,234,667	92,406,768	47.8	52.2
1955-56	44,281,262	47,488,763	91,770,025	48.3	51.7
1956-57	42,599,738	42,549,635	85,149,373	50.0	50.0
1957-58	46,863,878	45,425,019	92,288,897	50.8	49.2
1958-59			90,142,957		
1959-60	44,408,179	46,981,622	91,389,801	48.6	51.4
1960-61	43,093,826	46,637,329	89,731,155	48.0	52.0
1961-62	43,877,946	44,362,634	88,240,580	49.7	50.3
1962-63	44,475,418	34,313,914	78,789,332	56.4	43.6
1963-64	51,961,658	59,708,919	111,670,577	46.5	53.5
1964-65	49,295,438	37,913,804	87,209,242	56.5	43.5
1965-66	52,338,991	45,587,004	97,925,995	53.4	46.6
1966-67	51,616,827	38,467,819	90,084,646	57.3	42.7
1967-68	49,283,320	35,485,830	84,769,150	58.1	41.9
1968-69	54,984,800	30,063,791	85,048,591	64.7	35.3
1969-70	60,898,328	29,659,004	90,557,332	67.2	32.8
1970-71	59,918,301	27,549,027	87,467,328	68.5	31.5
1971-72	60,335,633	27,788,128	88,123,761	68.5	31.5
1972-73	60,246,365	26,143,748	86,390,113	69.7	30.3
1973-74	59,529,258	25,130,842	84,660,100	70.3	29.7
1974-75	61,220,000	27,669,000	88,889,000	68.9	31.1

SOURCE: Statistics Canada, "Grain Trade of Canada" 1954-55 to 1973-74, Cat. No. 22-201, Ottawa, and "Grain Milling Statistics", July and August 1975, Cat. No. 32-003, Ottawa.

TABLE VII - 2

Exports and Domestic Use of Canadian Milled Flour

Year	Wheat Flour Produced Including Low Grades	Wheat Flour Exported	Wheat Flour Used Domestically
		(Hundredweight)	
1930-31	31,296,684	13,331,259	17,965,425
1931-32	28,677,748	10,551,844	18,125,904
1932-33	29,425,215	10,526,401	18,898,814
1933-34	29,286,824	10,691,087	18,595,737
1934-35	27,770,497	9,310,608	18,459,889
1935-36	29,246,262	9,758,677	19,487,585
1936-37	27,928,060	8,870,303	19,057,757
1937-38	25,220,747	7,074,926	18,145,821
1938-39	29,786,702	9,024,320	20,762,382
1939-40	34,845,490	13,291,479	21,554,011
1940-41	38,368,633	20,166,101	18,202,532
1941-42	39,015,252	20,003,325	19,011,927
1942-43	46,237,411	24,647,421	21,589,990
1943-44	47,635,513	26,390,167	21,245,346
1944-45	48,284,414	27,290,711	20,993,703
1945-46	52,018,498	28,261,547	23,656,951
1946-47	56,033,374	33,116,617	22,916,757
1947-48	47,353,004	26,776,683	20,576,321
1948-49	39,944,794	20,947,620	18,997,174
1949-50	39.708,032	19,896,136	19,811,896
1950-51	46,315,153	24,356,912	21,958,241
1951-52	46,771,184	22,258,324	24,512,860
1952-53	46,776,625	24,609,199	22,167,426
1953-54	40,769,909	20,142,824	20,627,085
1954-55	40,606,599	17,692,945	22,136,654
1955-56	40,148,750	17,391,300	22,757,450
1956-57	37,623,446	14,582,431	23,041,015
1957-58	40,819,678	17,556,886	23,262,792
1958-59	39,826,493	16,141,267	23,685,226
1959-60	40,344,578	16,073,893	24,270,685
1960-61	39,914,644	15,513,836	24,400,808
1961-62	39,539,651	13,892,676	25,646,975
1962-63	35,505,220	11,854,458	23,650,762
1963-64	50,103,569	23,873,978	26,229,591
1964-65	39,107,358	13,714,069	25,393,289
1965-66	43,531,263	16,576,117	26,955,146
1966-67	39,978,571	13,848,208	26,130,363
1967-68	37,755,841	10,734,857	27,020,984
1968-69	37,621,151	10,705,452	26,156,699
1969-70	39,640,459	11,723,205	27,917,254
1970-71	38,534,863	10,802,813	27,732,050
1971-72	39,071,806	10,745,908	28,325,898
1972-73	38,049,127	10,154,053	27,895,074
1973-74	37,377,341	8,173,422	29,203,919
1974-75	39,020,000	8,132,989	30,887,011

TABLE VII - 3

Flour Mills In Canada By Province
(1954-1975)

Year	Nova Scotia	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Canada
1954	--	5	58	11	10	14	3	101
1956	--	4	45	7	9	11	2	78
1958	--	4	41	7	9	10	2	73
1960	--	4	38	7	8	9	2	68
1962	--	4	37	8	7	9	3	68
1964	--	4	37	6	6	10	4	67
1966	--	5	34	6	7	9	4	65
1968	--	5	28	6	6	9	4	58
1970	1	5	24	6	6	8	4	54
1972	1	4	21	5	6	6	2	45
1975	1	4	20	5	5	6	1	42

SOURCE: Statistics Canada, "Flour Mills", Cat. No. 32-215, Ottawa. Statistics Canada, "Flour Mills and Feed Mills in Canada", Cat. Nos. 32-401,501, 503, and 504, Ottawa.

mills are located in the East with the bulk of these in Ontario.

The industry has operated far below capacity for many years (Table VII - 4). At present the industry is operating between 20 percent and 25 percent below capacity. Western mills represent a disproportionately large share of this excess capacity.* The obvious question then is 'what locational advantages exist in the flour milling industry which might explain this excess capacity?'.

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* Tangri, Om P. and E.W. Tyrchniewicz, "The Removal of the Crow's Nest Pass Rates on Grain and Grain Products Moving to Eastern Canada for Domestic Consumption: Implications for Industrial Development and Expansion in the Prairie Provinces, Especially Manitoba", August, 1971.

TABLE VII - 4

Percentage of Mill Capacity In Operation
1953-54 to 1973-74

Year	Percentage of Capacity
1953-54	70.1
1954-55	71.7
1955-56	73.7
1956-57	69.3
1957-58	74.7
1958-59	76.2
1959-60	78.0
1960-61	82.6
1961-62	81.5
1962-63	70.0
1963-64	94.3
1964-65	76.7
1965-66	85.4
1966-67	78.8
1967-68	80.2
1968-69	73.9
1969-70	77.7
1970-71	76.9
1971-72	75.9
1972-73	76.0
1973-74	74.4

SOURCE: Statistics Canada, "Grain Trade of Canada", 1954-55 to 1973-74, Cat. No. 22-201, Ottawa.

An examination of the technical features of the flour milling industry suggests that it may be quite market oriented for domestic use of flour but that for export flour, the mill located near the raw material may have the locational advantage. The following features support the argument with respect to the domestic market.

1) Domestic flour moves exclusively by rail (or truck over short distances). Wheat, on the

other hand, can also be moved by water. Since there is no competition between rail and water for flour traffic one would expect freight rates on flour to be higher than those on wheat.

2) Domestic orders are usually relatively small and are filled with bagged flour. Since bagged flour is more difficult to load and unload from box cars than wheat and since bagged flour is unable to exploit the more efficient hopper cars as wheat does, one would expect still higher freight rates.

3) The domestic consumers of flour often take delivery in less-than-carload-lots. The local miller has a decided advantage in supplying such a market because of the extra cost and inconvenience of less-than-carload-lots.

In the case of the export market for flour, factor 3) above does not hold. Factors 1) and 2) are offset by the advantages that the Western mill has in being located in the wheat growing area.

1) The flour mill located in the wheat production area does not require as large an inventory of wheat as a mill located elsewhere. Wheat can be drawn from farms or primary elevators quickly.

2) These mills have the choice of rail, commercial trucking or direct delivery by producer to move grain to the mill.

3) There is significant weight reduction involved in the milling of wheat into flour. The milling process yields an average of one hundredweight of flour for every 2.3 bushels of wheat milled. This involves a weight reduction of 27.5 percent (from 138 pounds to 100 pounds.

This hypothesis is largely borne out by the facts. Domestic flour use is almost entirely supplied by local mills. Production for the export market is centered in the west, at the source of the raw material, rather than in British Columbia or on the seaway as

might be expected if the industry was market oriented with respect to the export market.*

Given this feature of the Canadian milling industry, it is possible to explain the distribution of excess capacity observed in Canadian mills. Table VII -1 illustrates the trends in the domestic and export markets for Canadian flour over the last 40 years. The peak year for Canadian flour mills was experienced in 1946-47 when over 56 million hundredweights of flour were milled. Of this total, 33 million were exported and 23 million were used domestically. Since the 1946-67 crop year, exports have gradually declined.

As Table VII- 1 indicates, exports have become fairly stable (although they do exhibit minor declines) at just over 10 million hundredweights per year.** This trend has been partially offset by increases in the domestic use of flour. Over all, however, Canadian flour production has declined some 30 percent from its peak of 56 million hundredweights in 1946-47 to 39 million hundredweights in 1974-75.

Since Western mills have traditionally produced flour for the export market, and since this market has declined significantly the disproportionately high amount of overcapacity in Western mills is explained. Table VII -1 illustrates the shift in level of production

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* Almost half of the production of Western mills has traditionally been exported. Only 15 percent of Eastern milled flour is exported on the other hand (see Tangri and Tyrchniewicz, op. cit.)

** This decline in exports is occurring despite the fact that the world trade in flour has increased each year. The net result has been a considerable drop in Canada's share of the world flour market.

from the West to the East since 1954-55.

There is no evidence that the trends observed above will be reserved in the near future. It does appear though, that they may be moderating (particularly the decline in exports).

Given this overview of the industry, it is now possible to understand more fully the intricacies of the flour milling operating practices. In the next section, the present operating practices of Canadian flour mills are examined. The discussion emphasizes the differences between the practices of Eastern and Western mills in order to facilitate the comparative cost analyses that follow.

DESCRIPTION OF THE PRESENT OPERATING PRACTICES OF EASTERN AND WESTERN MILLS

One of the predominant elements of the present flour milling industry is the part played by the Canadian Wheat Board. The Canadian Wheat Board purchases all milling wheat from the farmer at the point of delivery. This ownership is maintained until the wheat is sold to foreign buyers at Vancouver or Thunder Bay, or, in the case of domestic buyers, until the wheat is about to be milled. In the latter case, the Canadian Wheat Board pays all freight, storage and carrying charges on the wheat until it is milled. Domestic mills pay the Canadian Wheat Board 'in-store Thunder Bay' for the wheat plus (or minus) freight and handling to their mill. Storage and carrying charges on wheat stored in Canadian mills are paid for out of Canadian Wheat Board funds.

The Canadian Wheat Board functions as an extension of the producer. It purchases the wheat, takes responsibility for transporting it to the terminals, pays for inspection, elevation, cleaning, etc. Each year the costs of the Canadian Wheat Board are deducted from the surplus generated from selling the wheat and the difference is paid to the producer as a final payment.

A second participant in the system is the federal government. The federal government affects the industry in a number of ways. Firstly, it enforces the current two price system for domestically used milling wheat. The domestic mill is required to pay $3.25 for spring wheat and between $3.25 and $5.75 for durum depending on the world price. If the world price rises above the maximum prices to millers ($3.25 for spring wheat and $5.75 for durum) the Canadian Government makes up the difference to a maximum of $1.75 per bushel. The ceiling prices to producers then are $5.00 per bushel for spring wheat and $7.50 per bushel for durum.

Secondly, the Federal Government regulates certain freight rates. In the West, the statutory grain rates reduce transportation costs to flour mills on much of their product. In the East, the "at and east" subsidy reduces the rail freight charges on grain and flour shipped to eastern seaports.

Thirdly, the Federal Government subsidizes users of the St. Lawrence Seaway by charging tolls which do not cover the full costs of the Seaway.

Finally, the Federal Government subsidizes producers and/or some

buyers of feedstuffs through the Feed Freight Assistance Program and indirectly through corn tariffs.

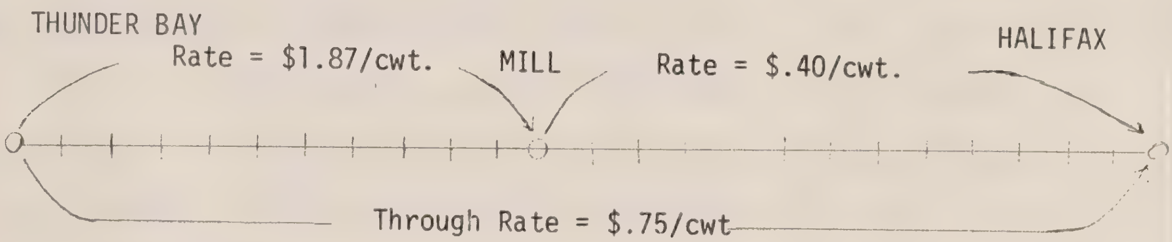
The details of the programs and the distortions that they create will be discussed in a later section.

Eastern Mills

Eastern Mills, those east of Thunder Bay, purchase milling wheat, basis in-store Thunder Bay plus freight and handling costs to their mills. The mills have the choice of moving this wheat by water, rail or a combination of water and rail. The choice of transportation mode is closely related to the market for the flour. Wheat milled for domestic markets usually moves via water from Thunder Bay to the mills while wheat milled for the export market moves by water to the Bay ports and by rail from there to the mills. This anomaly is created by the 'at and east' subsidy which only applies to export grain and flour.

Export bound flour is returned to rail and is shipped to a sea-port for export. Under the 'milling in transit' (M.I.T.) privilege, flour is effectively shipped at through rates from the Bay port to the point of export. The mills pay the railway a 'stop-off' fee plus the difference between the through rate and the rate already paid on the flour portion from the Bay port to the mills. The millfeed portion is effectively shipped at the rail rate in force from the Bay port to the mills. Figure VII - 1 illustrates how M.I.T. works to the advantage of mills.

Eastern millfeeds qualify for Feed Freight Assistance in Eastern Quebec and the Maritimes. Virtually all millfeeds are sold locally, however. The price realized then is almost entirely determined by the price of U.S. corn.



Charges	No Milling in Transit	Milling in Transit
Thunder Bay - Montreal	$1.87/cwt.	$1.87/cwt.
Stop-off fee*	--	$ .03/cwt.
Montreal - Halifax	$ .40/cwt.	$ .75 - 1.87 = -$1.12
	$2.27/cwt.	$ .78/cwt.

* Statutory Export Stop-off Fee = $ .03/cwt.

FIGURE VII-1 A Description of the Milling in Transit Privilege (Export Flour)

Western Mills

Western mills purchase wheat from the Canadian Wheat Board basis 'in-store Thunder Bay' less the statutory freight rate from the primary elevator to Thunder Bay. The mills have the choice of exercising the 'milling in transit' privilege, trucking the grain from the primary elevator to the mills or of offering a premium to producers who deliver directly to the mills. In the first situation, the mills pay the domestic freight rate from the primary elevator to the mills. East bound flour would qualify under the 'milling in transit' privilege. A 'stop-off fee' is paid on this portion of the product. The net freight charge on the movement of flour from the mills to Thunder Bay is then equal to the statutory rate between the primary elevator and Thunder Bay, less the domestic rates already charged for the movement of the flour portion from the primary elevator to the mills. In addition, the mills must pay a 3.0 cent 'diversion charge' to the Canadian Wheat Board which is used to compensate the primary elevator company for its loss of terminal elevator revenues on the grain.

In the second situation, the mills save the 'stop-off fee' and any difference in the statutory rate associated with the mill as compared to the primary elevator. Instead the mills pay for the cost of trucking the grain. If this cost is less than the 'stop-off fee' plus the difference in statutory rates at the mill as compared to the primary elevator, then this alternative is more attractive.

If the third alternative is chosen, that of encouraging direct producer delivery, the mills can offer a premium of up to the cost of

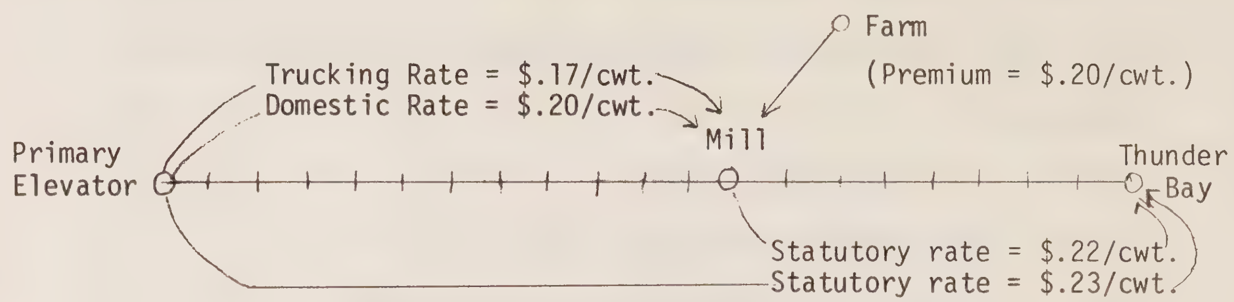
commercial trucking plus the 'diversion charge'. Figure VII - 2 compares these three alternatives.

Once the wheat is milled, the flour is sold in one of three markets:

1) the local market
2) the Eastern domestic market, or
3) an export market through Vancouver or an Atlantic port.

Flour exported through Vancouver and all flour shipped to Thunder Bay moves at statutory rates. From Thunder Bay, export bound flour moves via rail to Atlantic ports at the 'at and east' freight rates. Flour moving into eastern markets moves at domestic rail rates east of Thunder Bay.

Millfeeds are usually sold locally or are exported through Vancouver. Despite the fact that the Western millfeeds are eligible for statutory rates to Thunder Bay and for Feed Freight Assistance into Maritime markets, Western mills no longer are able to compete in this market.



Charge		M.I.T.	Trucking From Primary Elevator	Producer Delivery
Primary elevator - mill				
-- Rail Freight		$ .20/cwt.		
-- Truck Freight			$ .19/cwt.*	
-- Mill door premium				$ .22/cwt.*
Diversion Charge		$ .03/cwt.	$ .03/cwt.	
Stop-off Fee		$ .18/cwt.		
Mill - Lakehead	$ .23 -$ .20 =	$ .03/cwt.	$ .22/cwt.	$ .22/cwt.
TOTAL CHARGES		$ .44/cwt.	$ .44/cwt.	$ .44/cwt.

* This is the maximum amount considered by the Western miller. If wheat can be secured at a lower truck freight charge or mill door premium savings are made over the M.I.T. option.

FIGURE VII-2: A comparison of Western Mills' alternative means of procuring milling wheat.

DISTORTIONS IN THE FLOUR MILLING INDUSTRY

There are several ways in which the present situation in the flour milling industry might be considered distorted.

Canadian Wheat Board

The Canadian Wheat Board, in its "in-store Thunder Bay" price of milling wheat, includes a number of costs which it incurs. These costs are associated with the service rendered by the Board (including inspection, freight, terminal elevation, cleaning, Canadian Wheat Board administrative costs, etc.). Western mills buy milling wheat at this price less freight. They must, therefore, pay for these other services despite the fact that they do not receive them. Mills must have their wheat cleaned and inspected at their own cost and lose that part of their locational advantage of operating in the wheat producing area. It is estimated that the value of these services is about 7½ cents per bushel of grain purchased from primary elevators and 13¼ cents per bushel of wheat purchased directly from the producer. On the average this means an overcharge of approximately 10 cents per bushel or 23 cents per hundredweight of flour. Eastern mills, on the other hand, are overcharged less than half of this or approximately 11 cents per hundredweight of flour. See the Appendix for an analysis of Canadian Wheat Board overcharges to Canadian mills.

Mill Diversion Charge

When Western mills receive wheat from primary elevator companies, the Canadian Wheat Board collects, on behalf of the grain company, 3.0 cents

per bushel "diversion charge" in lieu of terminal elevator revenues.* This in effect requires the Western mill to pay for still more services which it does not receive.

Storage and Carrying Charges

One of the natural advantages of locating a mill near the source of milling wheat is the reduced need for storage. It is estimated that the year round average storage and 'bought to arrive'** requirement of a Western mill is less than one month. Eastern mills on the other hand require much higher storage levels. During the summer, the mills must have one month's supply of wheat in store and another month's supply in 'bought to arrive' position. Due to the closing of shipping during the winter, Eastern mills require a total of six months' supply in storage and in transit. This requirement declines by one month's supply, each month, until the end of March, at which time they require the minimum two months' supply again. This requires Eastern mills to have an average of three months' supply in storage and 'bought to arrive'.

Based on storage costs of over 1.0 cents per bushel per month and carrying charges of 3.44 cents per bushel per month,*** the monthly

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* Mills are required to pay an additional 1.5 cents per bushel "diversion charge" if the wheat that they secure contains less than 1 percent dockage. Since wheat in primary elevators seldom contains less than 1 percent dockage, this additional 1.5 cents per bushel is ignored in this analysis.

** The term "bought to arrive' refers to wheat in transit.

*** The carrying charges are based on a price of wheat of $3.75 per bushel and an interest rate of 11 percent, i.e. $3.75 x .11 ÷ 12 months.

cost of storing wheat is estimated at 4.44 cents per bushel. This results in a cost of 10.21 cents per hundredweight of flour for each month that a mill must store wheat. This would result in a 20.42 cents per hundredweight advantage involved in milling near the source of wheat. Since the Canadian Wheat Board pays all of the storage and carrying costs, the Western mills lose this comparative advantage. In effect, the Western farmer pays the cost of equalizing the storage costs of Eastern and Western mills.

Statutory Grain Rates

The statutory grain rates limit the freight rates applicable to most grain movement in Western Canada to ½ cent per ton-mile. Specifically, the rate applies to all grain and grain products moving by rail to Thunder Bay or to Churchill and all grain and grain products moving to Vancouver and Prince Rupert for export. The recently released report of the Commission on the Cost of Moving Grain by Rail suggests that the statutory rates are less than compensatory.

The effect of these rates on locational advantage in the flour milling industry is unclear. It is quite obvious that the West Coast area itself is discriminated against since the statutory rates apply to eastward, but not westward movements of grain and grain products to domestic users. The effect on the locational advantage of mills in the area is less clear, however, since the rates apply equally to the raw and the finished product. One would expect that this discrimination simply results in higher flour costs to consumers in British Columbia.

There are two other possible mechanisms by which this distortion might affect locational advantage. First, it is possible that a proportionate increase in these rates might amplify any locational advantages now existing. Since Eastern mills must move the raw product (including the flour portion of the millfeed portion) at the statutory rate while Western mills must move only the flour at the statutory rates (marketing at least some of the millfeeds locally), an increase in these rates may favour the Western mills.

Secondly, an increase in the statutory rates would mean that the options of commercial trucking from the primary elevator to the mill or of offering a premium for producer deliveries would be less expensive relative to the increased rail freight rates. Since these options are open only to Western mills, the effect of increasing the statutory rates may be to improve the position of Western mills relative to Eastern mills.

Feed Freight Assistance

The Feed Freight Assistance Program, while important to the milling industry in the past, will now play a much smaller role. In the East, millfeeds are usually sold locally. Mills outside the areas designated under the program are therefore unaffected. Only one Eastern mill (at Halifax) operates within the designated area and even here the millfeed buyer likely captures most of the subsidy paid.

Western mills market their millfeeds locally, in the British Columbia market and in the export market. Of these, only millfeeds

sold into the British Columbia market are eligible for subsidy under the Feed Freight Assistance Program. Again, the feeder would capture most of the benefits since the major substitute, feed grains from the prairies, is also eligible under the program.

At and East Subsidy

The 'at and east' is a Federal subsidy paid directly to the railways in return for rate concessions on export bound grain and flour. To receive the subsidy, the railway must move the grain or flour from an inland port (Thunder Bay or East) into export position in a Maritime or St. Lawrence port. In return for charging the shipper the same freight rate that was in effect on September 30, 1966, the government pays the difference between the above rate and the compensatory rate as estimated by the Canadian Transport Commission.

The 'at and east' subsidy, while available and used by both Eastern and Western mills, favours the Western mills to a greater extent than the Eastern mills. This statement is based on two arguments.

First, Western mills, in order to sell to the export market through Eastern ports, must use the rail service since bagged flour cannot easily be shipped by lake vessels into export position. Eastern mills on the other hand may employ either rail or water. Compensatory rail freight rates would be considerably higher than present water rates.*

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* It is quite possible that water rates would increase somewhat if the 'at and east' were abolished.

Secondly, Western mills receive a larger total benefit from the program since they export a larger proportion of their total production than do their Eastern counterparts.

Seaway Tolls

The present seaway tolls do not cover the full cost of the St. Lawrence Seaway. It has been suggested that users of the seaway should bear the operating costs of the seaway and share in the retirement of the debt incurred during its construction.

The effect of the low seaway tolls is almost entirely in favour of Eastern mills since Western mills do not ship flour by water.* Eastern mills are very heavily dependent on lake freight for the movement of wheat to be milled for domestic markets.

Corn Tariff

The next distortion to be examined is that caused by the Canadian tariff on United States corn. At present, this tariff adds 8 cents per bushel to the price of United States corn bought by Canadian feeders.

As producers of feedstuffs, for the Eastern market, the Eastern flour mills receive direct benefits from this tariff. As long as domestic production of feedstuffs are less than domestic consumption, the tariff increases the price of domestic feedstuffs by an amount equal to the level of the tariff.

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* To the extent that the railways compete with lake vessels, the lower lake freight rates may reduce the rail freight rates somewhat. The magnitude of this indirect effect is likely very small.

Under the new Feed Grains Policy, it is likely that Western mills also benefit from this tariff on domestic sales of millfeeds because the increase in the corn-competitive formula price will affect feed grain prices throughout Canada. The millfeeds which are exported are not affected by the tariff.

Stop-Off Fee Subsidy

Both Eastern and Western mills are subsidized through the stop-off fee on export movements of flour. However, the mechanism through which this subsidy is administered and the level of subsidy is different. The railways presently charge 18 cents per hundredweight stop-off fee on domestic flour shipments. In the East, the maximum allowable stop-off fee on export flour is set at 3 cents per hundredweight. In the West, the railways are free to charge the full 18 cents per hundredweight. The government then reimburses the Western mill 7.5 cents per hundredweight of export flour. As a result, the Eastern mill is subsidized 15 cents per hundredweight while the Western mill is subsidized only 7.5 cents per hundredweight.*

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* In 1975 the stop-ff fee was increased from 9 cents to 10.5 cents per hundredweight and then to 16 cents per hundredweight. The 7.5 cents per hundredweight subsidy was based on the 10.5 cents per hundredweight charge. The subsidy, however, was not increased to reflect the increase to 16 cents per hundredweight. The railways, on July 6, 1976 increased stop-off fees to 18 cents per hundredweight.

QUANTIFICATION OF DISTORTIONS IN THE FLOUR MILLING INDUSTRY

The distortions discussed in the last section each shift some of the competitive advantage associated with one location to other locations. The extent (and the direction) of these shifts vary from one market to another. The most satisfying means of analyzing these shifts in competitive advantage would be to determine the exact competitive advantage of each mill, in each market, with and without the distortion. In the absence of the large amount of detailed information necessary for such an approach, it is possible, instead, to estimate the changes in competitive advantage using partial budgets to compare costs.

This will be the approach taken in this section. Without attempting to determine the actual cost levels of firms, the changes in costs due to the distortions identified earlier will be estimated for two representative firms (one in Saskatoon and another in Montreal).

Assumptions

The analysis in this section is based on a number of assumptions about the practices of firms in the industry, the markets and costs. Each assumption is based on other analyses, interviews with members of the industry or analysis undertaken in this paper.

1) Western mills purchase milling wheat and market flour as follows:

Disposition	From Elevators Rail	Truck	From Producers	Total
Local Market	0%	35%	35%	70%
Export Market	20%	5%	5%	30%
TOTAL	20%	40%	40%	100%

2) Western mills sell their millfeeds as follows:

Prairies	5.6%
British Columbia	15.3%
Export through Vancouver	79.1%

3) Eastern mills market their flour and millfeeds as follows:*

	Flour	Millfeeds
Eastern Canada	85%	85%
Export	15%	15%

4) Each 2.3 bushels of wheat (60 pounds per bushel) are milled into 100 pounds of flour and 38 pounds of millfeeds. All values are expressed in hundredweights of flour equivalents (i.e. 100 pounds of flour, 2.3 bushels of wheat and 38 pounds of millfeeds).

5) The mill diversion premium is assumed to be 3 cents per bushel or 6.9 cents per hundredweight of flour.

6) Storage and carrying charges are assumed to be 4.44 cents per bushel per month. Translated into average cost per hundredweight of flour, this amounts to 10.21 cents for each month's supply of wheat that a mill must maintain on the average throughout the year.

7) Initially it is assumed that the statutory rates represent only one-half of the costs of moving grain. This suggests that the subsidy involved in the rates is 22 cents per hundredweight (Saskatoon to Thunder Bay).

8) The 'at and east' subsidy is assumed to reduce freight rates by 69.35 cents per hundredweight of flour, for flour moving by rail from Thunder Bay to Halifax.**

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* These percentages are based on figures in the Canadian Livestock Feed Board, Annual Report, Crop Year 1973-74.

** The Canadian Millers Association, "Elimination of the Subsidy on the Movement of Flour and Grain for Export Through Eastern Ports," a submission to the Minister of Transport, February 16, 1976.

It is assumed that this subsidy benefits only Western mills since Eastern mills have the option of using an all water route. Rough budgets indicate that there would be little or no increase in freight costs involved in switching from water-rail to all water transportation.*

9) The corn tariff is assumed to represent a 5.43 cents subsidy per hundredweight of flour equivalent, to millers selling millfeeds in the Eastern market. This is based on an 8 cent per bushel increase in the price of United States corn which results in an equivalent increase in the price of millfeeds.

10) The Canadian Government at present charges 1.2 cents per bushel seaway tolls. It is arbitrarily assumed here that this represents only 50 percent of the seaway costs. The subsidies involved then are 1.2 cents per bushel of wheat or 2.76 cents per hundredweight of flour equivalent.

11) The stop-off fee on export movements involves a 15 cents subsidy to Eastern mills and a 7.5 cents subsidy to Western mills. Since it has been assumed that two-thirds of export flour employs the Milling in Transit privilege, the average stop-off subsidy on export flour from Western mills is 5 cents per hundredweight.

Effective Subsidy

Given these initial assumptions, it is possible to estimate the effective subsidy on flour and millfeeds moving into each market. Table VII-5 summarizes these subsidies. This table demonstrates wide variations in the level of subsidy. The most subsidized flour market is the export of Eastern milled flour (56.50 cents per hundredweight). Flour sold in the West actually is burdened by a negative

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* Canada Grains Council, Appendices to Eastern Grain Movement Report, (Winnipeg: 1975).

TABLE VII - 5

Summary of Effective Subsidies to Eastern and Western Mills

	Eastern Mills					Western Mills						
	Flour			Millfeeds		Flour			Millfeeds			
	East	West	Export	East	Export	East	West	Export	East	West	B.C.	Export
C.W.B. Overcharge	-11.13	-11.13	-11.13	N/A	N/A	-22.75	-24.02	-19.78	N/A	N/A	N/A	N/A
Mill Diversion Charge	N/A	N/A	N/A	N/A	N/A	- 4.14	-3.45	- 5.75	N/A	N/A	N/A	N/A
Storage & Carrying	30.63	30.63	30.63	N/A	N/A	10.21	10.21	10.21	N/A	N/A	N/A	N/A
Statutory rates	22.00	22.00	22.00	8.36	8.36	22.00	--	22.00	8.36	N/A	N/A	8.36
At and East Subsidy	N/A	N/A	--	N/A	N/A	N/A	N/A	37.00	N/A	N/A	N/A	N/A
Seaway Tolls	2.76	2.76	--	N/A	N/A	--	N/A	--	2.76	N/A	N/A	N/A
Corn Tariff	N/A	N/A	N/A	5.43	--	N/A	N/A	N/A	5.43	5.43	5.43	--
Stop-off Subsidy	N/A	N/A	15.00	N/A	N/A	N/A	N/A	5.00	N/A	N/A	N/A	N/A
TOTAL	44.26	44.26	56.50	13.79	8.36	5.32	-17.26	48.68	16.55	5.43	5.43	8.36

subsidy of 17.26 cents per hundredweight. Table VII - 6 estimates the net effective subsidy and the distortion in favour of Eastern mills for each market for the flour and millfeeds and for the present marketing situation.

Table VII - 6 indicates that the most distorted single market is the Western market for flour. If Eastern and Western mills were to compete for the Western market, the locational advantage of the Western mill would be shifted away by the amount of 61.52 cents per hundredweight.

TABLE VII - 6

Net Effective Subsidies in Various Markets and the Related Distortion

Market	Net Effective Subsidy: Eastern Mills	Net Effective Subsidy: Western Mills	Distortion in favour of Eastern mills
	....	$ / cwt.	....
Export market for flour	56.50	48.68	7.82
Eastern market for flour	44.26	4.82	39.44
Western market for flour	44.26	-17.26	61.52
Eastern market for millfeeds	13.79	16.55	- 2.76
Present market shares	59.07	10.26	48.81

Given the present markets of Eastern and Western mills, the combined and weighted distortion in favour of Eastern mills is 48.81 cents

per hundredweight under the initial assumptions.* This estimate must be interpreted with a great deal of care. It must be remembered that this estimate of distortion is strictly static. The present market shares are symptoms of the distortions in each market. Changes in any of the component distortions would result in changes in the markets and market shares. The combined and weighted distortion simply indicates the relative cost differences imposed on mills in Saskatoon compared to Montreal as a result of transportation related distortions.

It is interesting to note that while a Saskatoon mill in total is presently being discriminated against by the amount of 49 cents to 60 cents per hundredweight of flour, its competitive advantage in the export market is only reduced by approximately 8 cents per hundredweight. The export market is the only market in which Eastern and Western mills are presently competing to any significant extent.

Another interesting observation is that Canadian mills are at present receiving a net subsidy in the export market. It must be remembered, however, that many of the effective subsidies considered in this paper also apply to the wheat sold to foregin mills with whom Canadian mills must compete for foreign flour markets. It is beyond the scope of this study to determine the effect of transportation related distortions on the competitiveness of Canadian mills with

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* This distortion is based on an interpretation of Canadian Wheat Board overcharges favourable to Eastern mills. Using an alternate set of assumptions, this distortion is as high as 59.68 cents per hundredweight. See the Appendix for an elaboration of this point.

foreign mills for export markets. Therefore the net effective subsidies in the export market should not be interpreted as an indication that the competitiveness of Canadian mills is increased relative to foreign mills.

ANALYSIS OF ALTERNATIVE SCENARIOS

The preceding analysis estimates the total distortion in the present system. This distortion is measured in terms of the net subsidy per hundredweight of flour to Western versus Eastern mills. The same framework may be used to predict the effect of changes in subsidies, regulations and Canadian Wheat Board practices on the short run profitability of mills located in Saskatoon and Montreal. It must be stressed that this analysis applies to the short run situation only. In the long run, two types of changes would occur which this analysis is less capable of predicting. First, the location of milling activity would shift as locational advantages were altered. Second, markets and market shares would change as relative advantages in each market were altered. This analysis suggests the direction in which these changes would occur but not the extent. The calculation of distortion under present market shares is particularly misleading if it is considered in any light other than in the very short run.

The following section predicts the effects of two different sets of assumptions about subsidies, regulations and Canadian Wheat Board

practices. First, it will be assumed that the "at and east" subsidy and the related freight rate freeze is ended. The second scenario involves the removal of:

1) The Canadian Wheat Board overcharges,

2) Mill diversion charges, and

3) The payment of storage and carrying charges by the Canadian Wheat Board.

In each case, all other assumptions will remain unchanged.

Removal of "At and East" Subsidy

Table VII-7 summarizes the net effective subsidy in the various markets for flour and millfeeds under the assumption that the "at and east" subsidy is removed. Given the information in Table VII-7, the distortion in any market can be calculated. Table VII-8 lists the distortions (in cents per hundredweight of flour equivalent) in some of the markets for Canadian flour and millfeed and the aggregated distortion assuming present market shares.

Table VII-8 indicates substantial distortions in favour of Eastern mills in each market for flour. The aggregated distortion is 58.23 cents per hundredweight of flour.* By comparing Tables VII-6 and VII-8, it is possible to determine the impact of the removal of the "at and east" program.

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* Again it is important to note that assumptions upon which this estimate is based, are the most favourable possible for Eastern mills and thus 58.23 represents a minimum. The corresponding maximum is about 69.11. The actual distortion would fall somewhere within this range.

TABLE VII-7

Summary of Effective Subsidies to Eastern and Western Mills
(No At and East Subsidy)

	Eastern Mills					Western Mills						
	Flour			Millfeeds		Flour			Millfeeds			
	East	West	Export	East	Export	East	West	Export	East	West	B.C.	Export
C.W.B. Overcharge	-11.13	-11.13	-11.13	N/A	N/A	-22.75	-24.02	-19.78	N/A	N/A	N/A	N/A
Mill Diversion Charge	N/A	N/A	N/A	N/A	N/A	- 4.14	-3.45	- 5.75	N/A	N/A	N/A	N/A
Storage & Carrying	30.63	30.63	30.63	N/A	N/A	10.21	10.21	10.21	N/A	N/A	N/A	N/A
Statutory rates	22.00	22.00	22.00	8.36	8.36	22.00	--	22.00	8.36	N/A	N/A	8.36
At and East Subsidy	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Seaway Tolls	2.76	2.76	--	N/A	N/A	--	N/A	--	2.76	N/A	N/A	N/A
Corn Tariff	N/A	N/A	N/A	5.43	--	N/A	N/A	N/A	5.43	5.43	5.43	--
Stop-off Subsidy	N/A	N/A	15.00	N/A	N/A	N/A	N/A	5.00	N/A	N/A	N/A	N/A
TOTAL	44.26	44.26	56.50	13.79	8.36	5.32	-17.26	11.68	16.55	5.43	5.43	8.36

TABLE VII - 8

Net Effective Subsidies in Various Markets and the Related Distortion (No At and East Subsidy)

Market	Net Effective Subsidy		
	Eastern Mills	Western Mills	Distortion In Favour Of Eastern Mills
	....	¢/cwt.	....
Export market for flour	56.50	11.68	44.82
Eastern market for flour	44.26	4.82	39.44
Western market for flour	44.26	-17.26	61.52
Eastern market for millfeeds	13.79	16.55	- 2.76
Present market shares	59.07	- .84	58.23

Such a comparison indicates that the removal of the "at and east" subsidy and the associated freight rate freeze would increase the distortion in favour of Eastern mills in the export market for flour from 7.82 cents per hundredweight to 44.82 cents per hundredweight -- an increase of 473 percent.

The effect of this change on the aggregate situation (assuming present market shares) would be to increase the distortion in favour of Eastern mills by 9.42 cents for each hundredweight of flour produced. This represents an increase of 19.3 percent.

Removal of Canadian Wheat Board Overcharges, Mill Diversion Charges and Canadian Wheat Board Payment of Storage and Carrying Charges

Table VII-9 summarizes the net effective subsidy in each market for flour and millfeeds in second alternative scenario. Under these assumptions, the effective subsidy decreases in each of the Eastern mill's flour market but increases in each of the Western mill's flour market. As a result, the competitive position of Western mills is vastly improved.

Table VII-10 summarizes the levels of distortion which would result if the three market imperfections above were removed. Under these conditions, the competitive advantage of the Western mill in the export market for flour would be increased by 27 cents per hundredweight over that of the Eastern mill. Overall, the Eastern mill would still be the biggest benefactor of the imperfections, receiving 12.63 cents more subsidy on each hundredweight of flour milled. This is largely due to higher subsidies received on locally marketed flour and millfeeds than those received by the Western mill.

The differences between Tables VII-8 and VII-10 very vividly point out the consequences of removing some distortions while leaving others. The removal of the "at and east" subsidy in the absence of any other changes would compound an already serious overall distortion of locational advantage. Removal of the Canadian Wheat Board overcharge, the mill diversion charge and the payment of carrying and storage costs by the Canadian Wheat Board, on the other hand, would tend to moderate the present distortion. One consequence, however,

TABLE VII - 9

Summary of Effective Subsidies to Eastern and Western Mills

(No Canadian Wheat Board Overcharge, Etc.)

	Eastern Mills					Western Mills						
	Flour			Millfeeds		Flour			Millfeeds			
	East	West	Export	East	Export	East	West	Export	East	West	B.C.	Export
C.W.B. Overcharge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mill Diversion Charge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Storage & Carrying	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Statutory Rates	22.00	22.00	22.00	8.36	8.36	22.00	--	22.00	8.36	N/A	N/A	8.36
At and East Subsidy	N/A	N/A	--	N/A	N/A	N/A	N/A	37.00	N/A	N/A	N/A	N/A
Seaway Tolls	2.76	2.76	--	N/A	N/A	--	N/A	--	2.76	N/A	N/A	N/A
Corn Tariff	N/A	N/A	N/A	5.43	--	N/A	N/A	N/A	5.43	5.43	5.43	--
Stop-off subsidy	N/A	N/A	15.00	N/A	N/A	N/A	N/A	5.00	N/A	N/A	N/A	N/A
TOTAL	24.76	27.76	37.00	13.79	8.36	22.00	--	64.00	16.55	5.43	5.43	8.36

would be to make an abrupt reversal in the direction of distortion in the export flour market.

These examples stress the importance of carefully examining the impact of changes in a system such as this.

TABLE VII — 10

Net Effective Subsidies in Various Markets and The Related Distortion

Market	Net Effective Subsidy Eastern Mills	Western Mills	Distortion in favour of Eastern mills
	..... ¢/cwt.		....
Export market for flour	37.00	64.00	-27.00
Eastern market for flour	24.76	22.00	2.76
Western market for flour	24.76	--	24.76
Eastern market for millfeeds	13.79	16.55	- 2.76
Present market shares	39.57	26.94	12.63

CONCLUSIONS

Summary

This study has attempted to estimate the level of distortions from the 'natural' locational advantage in the Canadian flour milling industry. It is felt that this objective has been achieved with fair success. It is estimated that under present market shares, a flour mill in Saskatoon receives a net effective subsidy of approximately

ten cents on each hundredweight of flour (and the resulting by-products) produced. This compares with an estimate of 59 cents per hundredweight for a mill in Montreal. This 49 cents per hundredweight difference is considered a minimum. The difference could be as high as 60 cents per hundredweight.

Limitations

Caution must be exercised in the application of this study. The study is valid only within the context in which it was designed.

First, it is important to recall that the study does not attempt to determine the total costs of production or even the total transportation costs. It simply attempts to estimate the change in costs that would occur if certain imperfections were removed. It is impossible, therefore, to determine domestic market boundaries, for example.

A second point to remember is that the study deals in the relative rather than the absolute in many cases. An obvious example is the inclusion of the statutory rates. It is probable that the statutory rates represent a subsidy to producers and that if the rates were relaxed, the producers rather than the millers would pay the larger freight bill. This source of distortion is real, however, and has been included since producers would be willing to sell their wheat to a local milling at a lower price rather than pay the higher freight bill. The net effective subsidy figures are therefore relative. It is the difference between the comparable figure for Eastern and Western mills which is important.

Third, it is very important to keep in mind that the study deals with only two milling locations--Saskatoon and Montreal. As a result, one must be careful when making broad generalizations. The situation portrayed by the Montreal mill, for example, may be atypical of a mill in Halifax. The study is intended to be illustrative rather than exhaustive.

Next, the accuracy of the estimates is dependent upon the accuracy of the assumptions. The most suspect assumptions are:

1) those regarding the costs of Canadian Wheat Board services;

2) those regarding the Canadian Wheat Board services received by Eastern and Western mills;

3) that Eastern mills receive no benefit from the "at and east" rates;

4) that the statutory rates represent 50 percent of real costs; and

5) that the present seaway tolls represent 50 percent of real costs.

These assumptions are undoubtedly inaccurate to some extent. However, since there is no way of determining the magnitude or even direction of the inaccuracies involved, it is expected that they do not bias the results of the study significantly.

Finally, it must be pointed out that the study assumes a static situation. Sources of wheat and markets for flour and millfeeds are assumed to remain unchanged. It is likely that a change such as the relaxation of statutory rates would result in a change in the source of milling wheat for Western mills. Increased rail freight rates would allow a Western mill to pay higher truck freight and/or premiums

to producers. Abolition of diversion charges would tend to reduce direct deliveries since premiums would be reduced. These shifts in sources would only occur if they saved the mill money. The assumption that sources of wheat are static, therefore, results in an under-estimate of the size of the distortion.

Conclusions

Upon examination of specific components of the total distortion, several conclusions become obvious.

1) As a result of distortions in the industry, it is likely that Western flour consumers pay more for flour while Eastern and foreign consumers pay less than under a non-distorted market.

2) The locational advantage in the export market for flour is only slightly distorted in favour of a Montreal mill. It is therefore unlikely that the share of this market held by a Saskatoon mill has been reduced substantially by the distortions. This observation is of particular importance since this market is the only one in which there is any significant competition between Eastern and Western mills.

3) The Eastern market for flour is quite substantially distorted. It is possible in fact that this distortion (approximately 39 cents per hundredweight) protects Eastern mills from competition from Western mills. Removal of this distortion might allow Western mills to compete effectively.

4) The most distorted market is the Western market for flour. The competitive ability of Eastern mills is increased by over 61 cents per hundredweight of flour relative to their Western counterparts. Eastern mills are unable to compete in this market despite the distortion, however.

5) Only one element clearly distorts the system in favour of Western mills--the "at and east" subsidy. (See Table VII -11).

6) The major sources of distortion in favour of Eastern mills are the payment of storage and carrying charges by the Canadian Wheat Board, the statutory rates, and the Canadian Wheat Board overcharge.

This study indicates that Western mills are discriminated against by present policy and practices. However, this discrimination occurs largely in the local domestic market for flour and millfeeds. Removal of the distortions discussed in this paper could, in total, have a detrimental effect on Western mills if the subsidies involved were not also removed from export wheat.

TABLE VII-11

Summary of Effective Subsidies to Eastern and Western Mills By Source

Source of Distortion	Effective Subsidy: Eastern Mills	Effective Subsidy: Western Mills	Distortion in favour of Eastern mills
Canadian Wheat Board Overcharge	-11.13	-22.75	11.63
Mill Diversion Charge	--	- 4.14	4.14
Storage & Carrying	30.63	10.21	20.42
Statutory Rates	30.36	13.22	17.15
At and East Subsidy	--	11.10	-11.10
Seaway Tolls	2.35	--	2.35
Corn Tariff	4.62	1.13	3.49
Stop-off Subsidy	2.24	1.40	.84
TOTAL	59.07	10.26	60.71

Complete removal of distortions would increase the competitive advantage of Western mills over Eastern mills only marginally in the

export market. At the same time, the absence of subsidies could substantially impair the Canadian industry's ability to compete with foreign millers in the world market. The one possible exception to this observation is the possibility that Western mills could compete with Eastern mills for the Eastern domestic market. Total removal of distortions would improve Western mills' competitive ability relative to Eastern mills' by approximately 40 cents per hundredweight. An increase in competitive ability of this magnitude would certainly expand the boundaries of the Western mill's market area.

The study suggests that selective removal of distortions must be considered very carefully. Removal of the "at and east" rates for example would:

1) significantly increase the discrimination against Western mills in total;

2) seriously impair the competitiveness of Western mills relative to Eastern mills for the export market; and,

3) damage the Canadian milling industry's ability, in total, to compete in the world market.*

This study indicates the sensitivity of locational advantage in the Canadian Flour milling industry to subsidies, regulation and Canadian Wheat Board practices. The administration of these policies has inadvertently shaped the locational pattern (in the longer-run) and profitability (in the short-run) of Canadian mills. It is important

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* This is assuming that the corresponding subsidies on wheat sold to foreign mills are not altered.

that the results of these policies be critically compared with regional development objectives and that contradictions be removed.

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A P P E N D I X

ESTIMATION OF CANADIAN WHEAT BOARD

AGAINST CANADIAN MILLS

It is extremely difficult to accurately quantify the value of the various services which the Canadian Wheat Board provides while marketing Western Canadian wheat. One rough approximation of these values is the costs incurred by the Canadian Wheat Board while providing these services. Table VII - A.1 lists the costs which the Canadian Wheat Board deducts from operating surplus before the final payments to producers are determined.* These costs are less than perfect indicators of the value of Canadian Wheat Board services in two respects. First, the categories are somewhat ambiguous, often including several services. Second, the per bushel costs are averages over all wheat in the pool. This results in an underestimation of the cost of performing the service since the average includes wheat which did not receive the service as well as that which did.

In view of the lack of better estimates, these costs are used here to approximate the value of Canadian Wheat Board services. Table VII - A.1 lists the various costs which the Canadian Wheat Board includes in the price of a bushel of wheat.**

Each entry in the table indicates the value of that service to the mill in question. In the case of Western mills, the value of the

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* These cost categories and average costs are taken from the Canadian Wheat Board, Report To Producers on the 1974-75 Crop Year, page 14.

** It is a matter of debate whether Canadian Wheat Board costs represent a reduction in returns to producers or an increase in price to consumers. This analysis will proceed as if the cost represents an increase in price to consumers. Since the objective of this analysis is to determine the relative effect of the Canadian Wheat Board on Eastern and Western mills, it is largely an irrelevant question.

TABLE VII - A.1

Estimation of Canadian Wheat Board Over-Charges Against Canadian Mills

Canadian Wheat Board Operating Costs	Costs per Bushel	Value of Services Received: Eastern Mills	Value of Services Received: Western Mills, Purchased from Elevators	Value of Services Received: Western Mills, Purchased from Producers
	$/Bus.	$/Bus.	$/Bus.	$/Bus.
Carrying charges on wheat stored in country elevators	.0534	.0534	.0534	--
Storage on wheat stored in terminal elevators	.0198	.0198	--	--
Net interest paid to agency on agency wheat stocks	.0057	.0057	.0057	.0057
Country elevator administrative charges	.0050	.0050	.0050	.0025
Bank interest, exchange and net interest on other Board accounts	.0401	--	--	--
Demmurrage	.0083	--	--	--
Net additional freight on wheat shipped from country station to terminal positions	.0020	.0020	--	--
Handling, stop-off and diversion charges on wheat warehoused in interior terminals	.0027	.0027	--	--
Trucking from primary elevators into interior terminals	.0036	.0036	--	--
Drying charges	.0136	.0136	.0136	.0136
Administrative and general expenses	.0149	.0149	.0149*	.0149*
TOTAL VALUE OF SERVICES RECEIVED		.1207	.0926	.0367
TOTAL CANADIAN WHEAT BOARD COSTS PER BUSHEL	.1691	.1691	.1691	.1691
CANADIAN WHEAT BOARD OVERCHARGE		.0484*	.0765**	.1324**

* This figure is a high estimate

** This figure is a low estimate

service varies, depending on the means of obtaining the grain. The total of each column represents an estimate of the value of services provided by the Canadian Wheat Board in each situation. By subtracting this total from the total Canadian Wheat Board costs, one arrives at a rough estimate of overcharges.

The first cost component in Table VII - A.1 (carrying charges on wheat stored in country elevators) is the payments to country elevators for storage and carrying charges. Western mills do not benefit from this service when producers deliver directly to the mill. Eastern mills and Western mills buying grain from country elevators do benefit from this service.

The second component, storage on wheat in terminal elevators, is of benefit to Eastern mills only since wheat purchased by Western mills is never stored in terminal elevators.

Net interest paid to agents on agency wheat stocks is interpreted as carrying charges on wheat stocks in Canadian mills. Under this interpretation, all mills receive and pay for this service and the charge is therefore included in Table VII - A.1.

Country elevator administrative charges are monies paid (one-half cent per bushel) for paperwork incurred by country elevators. This service is received on all wheat milled. In the case of direct producer deliveries to Western mills, the Canadian Wheat Board pays only .25 cents to the mill. Therefore, the Western mills receive .25 cents less service. The .25 cents entered under producer delivered grain indicates that the Western mill (while paying the full .5 cents

for the service) receives only .25 cents of service (paying the other .25 cents out of pocket).

The next cost category, bank interest, exchange and net interest on other Board accounts, involves services of a general nature. It is therefore very difficult to estimate the value of these services to Canadian mills. The service involved in the exchange portion is clearly of no value to any Canadian mill. It will be assumed initially that the other services in this category are also of no value to Canadian mills.

The demurrage item in Table VII - A.1 is one of the easier items to handle. This cost is entirely composed of ocean vessel demurrage which is of no value to any Canadian mill.

The next three items--additional freight, interior terminal charges and interior trucking costs--are relevant only to Eastern mills since none of these costs are incurred by wheat purchased by Western mills.

The cost of drying is charged to both Eastern and Western mills. While Western mills often acquire wheat which requires drying, the Canadian Wheat Board makes an allowance for the cost of drying this wheat. Therefore, both Eastern and Western mills pay for the service only when the service is received.

Administrative and general expenses are difficult to allocate to the consumers of milling wheat. This category of costs undoubtedly includes components which vary with the distance between the producer

and the consumer (the mills).* It is difficult to argue that wheat delivered to the mill by the producer should incur the same charge for these types of services as wheat sold to Eastern mills. At the same time there are other components which are rightfully charged on a flat, per bushel basis.** In Table VII - A.1 Canadian mills are all charged administrative and general expenses. It should be remembered that this overestimates the value of services received by Western mills relative to Eastern mills (possibly by a large part of the charge for this component).

The estimates of overcharges in Table VII - A.1 are very crude. It is speculated here that the estimates exaggerate the overcharge for Eastern mills relative to Western mills. Table VII - A.2 illustrates these estimates and compares them with estimates which are more generous to the Western mills. It is likely that the two sets of calculations represent the extremes. The actual situation is probably closer to that represented by the alternate assumptions in Table VII - A.2***.

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* Services of this type include arrangements for carriers, costs of ownership, etc.

** This group includes such services as research, producer information, etc.

*** This is particularly so if one considers that this methodology underestimates the costs of most of these services. If only those buyers who used a service were required to pay for them, the unit charge for the service would be higher.

TABLE VII - A.2

The relative Canadian Wheat Board Overcharges under two sets of assumptions

	Original Assumptions*		Alternate Assumptions**	
	(¢/bus.)	(¢/cwt. of flour)	(¢/bus.)	(¢/cwt. of flour)
Eastern Mill Overcharge	4.84	11.13	.83	1.91
Western Mill Overcharge on:				
- wheat purchased from elevators	7.65	17.60	8.14	18.72
- wheat purchased directly from producers	13.24	30.45	14.73	33.88
- weighted average***	9.89	22.75	10.61	24.40
Difference in Overcharge (Western - Eastern)	5.05	11.62	9.78	22.49

* These calculations are based on the assumptions used in Table VII - A.1

** These calculations are based on the assumption that Eastern mills receive the full benefit of the bank interest, exchange, etc.,and that Western mills receive no benefit from administrative expenses.

*** These figures represent a weighted average of the figures for the two sources of wheat for Western mills. The weights used are .6 and .4 for wheat from elevators and wheat delivered directly by producers respectively. These weights are based on projection made by a Western miller.

The analysis above estimates the average subsidy per hundredweight of flour received by Western versus Eastern mills. These subsidies are distributed unevenly over the different markets for flour. In order to determine the effects of distortion in any given market, one must isolate the level of effective subsidy on flour moving into that market. The following assumptions are made to facilitate this analysis.

1) The Western mill receives milling wheat from three sources and sells flour in two markets. Table VII - A.3 illustrates the present 'supply of milling wheat' and 'disposition of flour' situation for Western mills.

TABLE VII - A.3

Supply of milling wheat and disposition of flour --The present situation for Western Mills

Disposition	Supply of Milling Wheat: From Elevators: Rail	Truck	From Producers	Total
Local Market	0%	35%	35%	70%
Export Market	20%	5%	5%	30%
TOTAL	20%	40%	40%	100%

2) For purposes of comparison it is assumed that if flour was sold in the Eastern market, the source of milling wheat would be in the same proportions as the totals (i.e. 20% by rail, 40% by truck and 40% directly from the producer).

Given these assumptions, the Canadian Wheat Board overcharges against Western mills are estimated in Table VII - A.4

TABLE VII - A.4

Canadian Wheat Board Overcharges against Western Mills
--three markets

	Market		
	East	West	Export
Portion of wheat purchased from elevators	60%	50%	83%
Portion of wheat purchased from producers	40%	50%	17%
Weighted average overcharge			
- original cost assumptions	22.75	24.02	19.78
- alternate cost assumptions	24.78	26.30	21.30

This rather crude analysis suggests a substantial element of discrimination against Western mills in present Canadian Wheat Board practices. The degree of discrimination would appear to fall between 11 cents and 25 cents per hundredweight of flour depending on how one interprets the meaning of the various Canadian Wheat Board cost categories and what market one is considering.